

Appendix K
Draft Flood Hazard Mitigation Plan

Lake County

Flood Hazard Mitigation Plan

Contents

Chapter 1. Introduction

Background.....	1-
Purpose.....	1-
Methodology.....	1-
The Setting for Flooding.....	1-
Development.....	1-

Chapter 2. Problem Identification

Lake County Watersheds	2-1
Methodology	2-4
Overview of Flooding.....	2-7
Flooding Sources	2-9
Flooding Impacts	2-14
Dollar Damage Estimates	2-19
Other Hazards	2-22
Future Flooding.....	2-23

Chapter 3. Watershed Summaries

Fox River Watershed	3-1
Des Plaines River Watershed.....	3-10
Lake Michigan Watershed.....	3-16
North Branch of the Chicago River	3-21

Chapter 4. Repetitive Losses

Background.....	4-1
Property Protection Measures	4-4
Neighborhood Plans.....	4-8
Acquisition.....	4-14
Recommendations.....	4-16

Chapter 5. Mitigation Strategies and Measures

Prevention	5-2
Property Protection	5-13
Natural Resource Protection	5-22
Emergency Services	5-27
Flood Control	5-35
Public Outreach	5-43

Chapter 6. Goals

1. Protect public health and safety.	6-1
2. Reduce property damage	6-1
3. Maintain the drainage system.	6-2
4. Enhance floodplain quality.	6-2
5. Establish a coordinating system	6-2

Chapter 7. Partners in Flood Mitigation

Stormwater Management Commission	7-1
County Agencies	7-2
Local governments	7-6
State Agencies	7-8
Federal Agencies	7-9
Private Organizations	7-10
Flood Mitigation Task Force	7-11

Chapter 8. Action Plan

Protect public health and safety.	8-
Reduce property damage	8-
Maintain the drainage system.	8-
Enhance floodplain quality.	8-
Establish a coordinating system	8-

Appendix A. Subwatershed Flood Problem Summaries

Appendix B. Studies and References

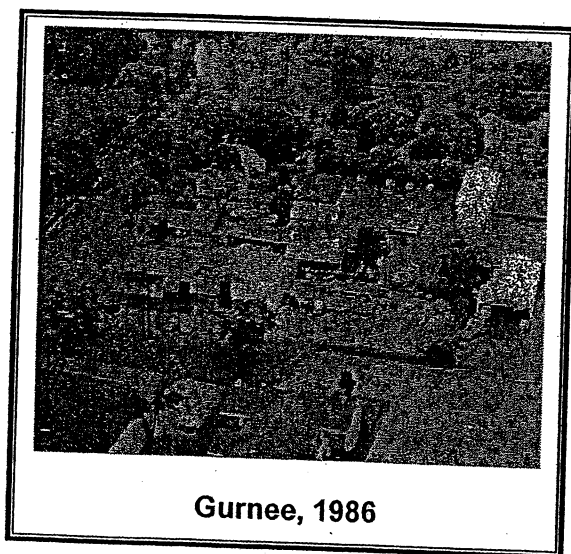
Appendix C. Flood Problem Inventory Form

Chapter 1. Introduction

Background.....	1-1
Purpose.....	1-2
Methodology.....	1-2
The Setting for Flooding.....	1-3
Development.....	1-5

Background

Lake County has a long history of flooding, but the severity of flood damage has increased dramatically in recent years as the County has become more urbanized. The County's vulnerability to flood damage became obvious with the floods of 1979, 1982, 1986, 1987, 1993 and most recently in 1996. Since 1982, Lake County has been declared a federal disaster area two times and a state disaster area five times.



Following the 1987 flood, the County took advantage of a new state law and created the Stormwater Management Commission (SMC). Since then, the County has adopted a comprehensive wa-

tershed management plan and ordinance. These activities have helped curb the increase in flooding and have improved water quality, but they have not had much of an impact on existing development exposed to flooding.

To reduce flooding to developed areas, the SMC has initiated a program of flood control projects, both large and small, in cooperation with local, state and federal agencies. These projects tend to be expensive and some project plans are not implemented because of their high costs or environmental impacts.

Non-structural activities, such as acquisition, floodproofing, flood response plans, and public information programs are alternative approaches that can complement the regulations and flood control projects.

A mitigation plan identifies structural and nonstructural activities that should be implemented to prevent the same damage being repeated by the next flood. One of the first conclusions from the 1993 flood was that a mitigation plan would have helped tremendously. It would have guided reconstruction and redevelopment of flooded areas, cleared out heavily damaged areas, and taken advantage of post-disaster funding programs.

Mitigation plans are also a prerequisite for mitigation funding that help finance measures that prevent or reduce damage from future flooding. The County took advantage of one of the grant programs following the 1993 flood. The Department

of Housing and Urban Development provided Community Development Block Grant funds for the work needed to draft this plan and help the County prepare for future flooding.

Purpose

This document is the culmination of a five year effort to:

- identify known flood problems areas,
- describe the flooding problems,
- review measures that would help address the flood problems,
- select those mitigation measures best suited for Lake County, and
- identify recommend activities that would best implement those measures.

This plan does not propose to control flooding or eliminate all flood problems. It does not provide enough information to determine specific flood protection measures at any one location. However, it does set overall guidelines and recommendations on how the impacts of future flooding can be mitigated through programs that are implemented throughout the County and more detailed planning for individual sites.

Methodology

This plan was prepared by SMC staff with support and assistance from a variety of local, state, federal and private offices. Plan preparation followed the process recommended in *Flood Hazard Mitigation in Northeastern Illinois: A Guide for Local Officials*, prepared by the Northeastern Illinois Planning Commission after the 1993 flood. That process has 8 steps:

1. *Organize*: a planning team was assembled led by SMC's principal planner, Alan Schlindwein and later Patricia Werner. The firm of French &

Associates was contracted to provide technical and staff support. Cyndie Wilhelm was devoted to the effort full time for the first year.

2. *Hazard inventory*: Cyndie collected and compiled data from existing flood studies and damage reports. She interviewed other County agencies, County Board members, local officials from every city, village and township and many neighborhood representatives. A database and GIS mapping system were developed to record the data collected. This effort was capped by visits to over 300 sites. The information is summarized in Chapter 2.
3. *Problem assessment*: Concurrently with the hazard inventory, Cyndie collected data on the impact of flooding on people, property, public health and natural resources. This included reviews of existing studies and reports, analysis of disaster assistance and flood insurance claims data, and the site visits. This information is also summarized in Chapter 2.
4. *Coordinate*: Throughout the planning effort, SMC kept in touch with local, state and federal agencies involved in activities that can affect flooding and flood damage. They supplied flood damage inventories and reports from past flood events. Many of the agencies sent representatives to the several workshops that were held to review progress and collect input.
5. *Review mitigation measures*: All activities that can affect flooding and flood losses were reviewed. How they work and how they could be used in Lake County are the subjects of Chapter 3 of this plan.

6. *Public input:* Two-way communication with the general public was accomplished in several ways. The site visits resulted in long discussions with individuals.

Over 170 people participated in four workshops that were held in 1995, at the beginning of the planning work, to collect information on problem sites and local interests in mitigation measures. Three workshops were held when the plan was drafted in 1999 to solicit feedback on the plan's contents, goals and recommendations.



1995 Planning Workshop

7. *Draft action plan:* The end result of this effort is an action plan, i.e., a series of specific activities to be implemented by a designated office by a certain deadline. The action plan is included at chapter 5 of this document.
8. *Implement and evaluate:* Once adopted by the Stormwater Management Commission, staff from SMC and the other designated agencies will implement their respective assignments. The Mitigation Advisory Committee will monitor the projects and will prepare an annual evaluation report for the Commission and the

public. This provides an ongoing, self-correcting system to keep the plan pertinent and effective.

This 8-step process needed only a few modifications for this plan to qualify as a flood hazard mitigation plan for FEMA's grant programs and as a floodplain management plan for credit under the Community Rating System (CRS). For example, for CRS credit, a ninth step was needed: setting goals and objectives for the plan. This has been included as Chapter 4.

The Setting for Flooding

The glacier: Everything about Lake County's watersheds and drainage patterns were created at the end of the Wisconsin glacial period. As the last glacier retreated 10,000 years ago, materials scraped from as far away as Canada were deposited here. At some locations, huge blocks of ice were buried in this glacial till, which took some time to melt. When they did finally melt, the results were large depressions.

Melt water accumulated on top of, within and under the glacier and also behind moraine dams. Every so often this accumulated melt water would break out and cause a flood of extraordinary proportions that flowed across the County. These floods shaped and re-shaped the valleys. Much of the valley bottom deposits that we have today started accumulating during these prehistory floods.

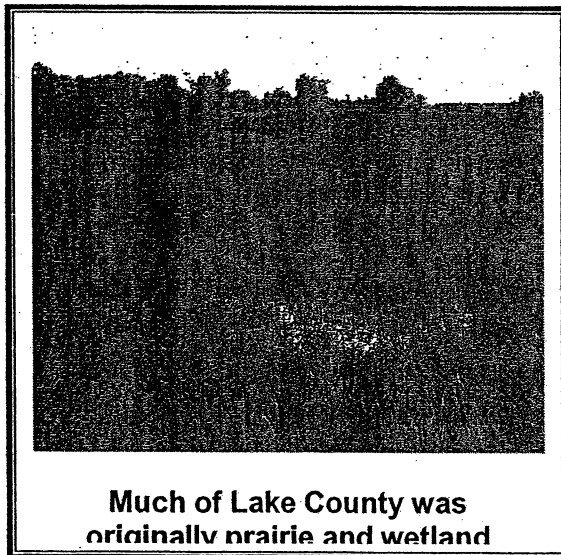
For a while after the glacial retreat, Lake County was a very wet and muddy place. In the cold, little plant growth was possible, partly because the soils were so poor. It took thousands of years of freeze and thaw to break down the glacial materials into the soils we have today. The County was covered with lakes including Lake

Chicago, which was a much larger and deeper predecessor to Lake Michigan.

The bare, poorly consolidated glacial material was easily eroded by snow melt and rain fall. The muddy runoff washed tremendous quantities of material into the new lakes. Many of the inland lakes simply filled in, to become the wetlands we have today. Along Lake Chicago, the runoff dumped the glacial materials along the prehistorical shoreline.

These lake bottom deposits were exposed when Lake Chicago dropped down to the level of today's Lake Michigan. Streams then cut deep ravines down through the exposed area that we now call the Bluffs. Lake Michigan also eroded the shoreline to create the steep slopes of the Bluffs. These eroded materials were re-deposited offshore, creating the sand dunes now found at Illinois Beach State Park.

The prairie: Eventually grasses colonized the glacial landscape. These prairie grasses stabilized the soil and added organic material. The deep roots of prairie grasses dropped the water table through plant transpiration. When it rained, the roots channels sponged the rainfall into the ground.



Wildfires maintained the prairie grasses by burning out the trees. On the north and east sides of wetlands, lakes and rivers, there were fire shadows where thickets of trees were able to grow. The trees also invaded marshes to form woody swamps.

During this period, flooding in Lake County was negligible. When it rained, first the plants absorbed water when they got wet, then the ground sponged up the water. Only during great rain events did runoff result. Even then, though, the grasses and trees slowed the movement of water down through the swales, wetlands, streams, sloughs and rivers.

When the native American Indians arrived, they found a diverse landscape full of game. They settled in the wooded areas, because of the fuel, building materials and shelter from winter winds. However the woods were located next to the water features, which were the most flood prone areas of Lake County. The Indians were semi-nomadic. When they had exhausted an area of fuel and game, they would relocate.

When Joliet and Marquette came up the Illinois River, they found only one channel at the confluence of the Des Plaines and Kankakee Rivers. The Des Plaines was a broad swale full of marsh grasses and the occasional slough, hence the name "the plains." Joliet and Marquette documented the first recorded flood in the Illinois River watershed. They were driven from a riverside camp in 1673.

The first Europeans in the area were explorers and Indian traders. These people were even more nomadic than the American Indians. In the period before agricultural settlement, flooding merely represented a temporary delay in early American boat traffic.

Development

Farms: In the first half of the 19th Century, the European settlers migrated to the upland areas of Lake County and converted the prairie into row crops. This conversion of land also started a conversion of flooding regime. The shallow rooted row crops were less efficient at holding back rainfall and the large expanses of bare ground resulted in very muddy runoff. The receiving lakes and streams had to absorb ever increasing levels of water and sediments.

The system of roads to the markets in Chicago and Waukegan provided the economic incentives to convert marginal lands. Forests were cut down for fuel and lumber and the wet prairies converted to row crops and pastures. The European settlers discovered that the soil was easy to ditch. Soon channels were created that drained the marshes. Wooded swamps were lumbered. The results of the conversion of marginal land to agriculture was to increase the amount of runoff and at the same time to develop a faster way of moving the runoff downstream.

The development of tile drains was a boon to agriculture. Farm drains could be put underground to provide more arable land. Underground tiles did not have channel banks that collapsed into the ditch with the first flood. They also drew the water table to lower levels, which proved to be the only way to drain many depressional areas.

The consequence of tiling was to further increase the rate of runoff while simultaneously removing the surface storage areas needed to hold this runoff. Tiling thus further increased downstream flooding.

Communities like Gurnee, Libertyville and Half Day, noticed that the rivers and streams came up much faster, flooded deeper and stayed up longer than they had in the past. Even so, flooded buildings were not likely to suffer much damage as they were made of wood and had simple stove heating, few electrical conveniences and removable throw rugs.

Lake County's record setting flood of 1938 became only a bit of town lore in Grayslake as the "day that fish swam down main street." Crop damage was the main economic impact of flooding before World War II.

Suburbs: Eventually other enterprises started to compete with agriculture for land. Lakefront recreation was a particularly good business. Well-to-do city dwellers would send their families to the lakes during the hot summers and visit on weekends during late spring and early fall. During winter and early spring floods, these lake front cottage communities were virtual ghost towns.

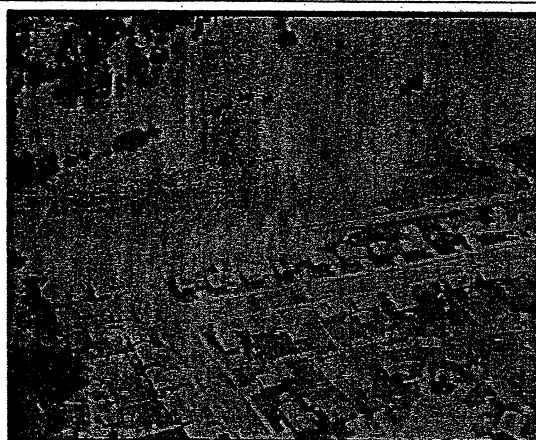
Many of these communities were built on lakefront lands that were extremely low and easily flooded. However, these cottages were seasonally occupied and the contents generally Spartan.

Over time, though, the cottages were improved and became year round residences. This movement was advanced by three factors: retirees moved to their summer homes permanently (air conditioning helped), commuters had access to downtown jobs thanks to an improved transportation system, and more and more jobs came out to the County as suburbanization continued.

Erosion from farm lands and construction sites was filling in the lakes. In order to maintain boating, the water level on the lakes was raised through dams. Raised lake levels brought raised flood levels and more frequent flooding to these lakefront cottages.

The final development trend that changed flooding in Lake County started in earnest after World War II. The Chicago area underwent a huge suburban building boom. In Lake County, many of the early subdivisions were placed in questionable locations. When the farmers started selling off their land, they generally tried to rid themselves of unproductive low lands.

Suburban development brought houses, businesses, factories, schools, parking lots and roads, all of which have surfaces impervious to rainfall. Impervious surfaces generate four times as much runoff as agricultural fields. As farm fields were converted to more intensive uses, the rates of runoff increase dramatically. Many of the low areas thought to be safe, started flooding.



Suburbs crept into farmland and floodplain

With the building boom also came increased erosion. The disturbed building sites were easily eroded by rainfall which delivered sediments into the lakes and streams. Lakes became shallower and many of the man-made drainage ditches started filling in with construction sediments.

While farmers maintained their drainage ditches, under urbanization the ditches became the property of many owners who knew little about protecting them from bank erosion and sedimentation. The lost channel conveyance resulted in the flooding of many of these new developments and existing communities.

Recent floods: This building boom also corresponded to a cyclic change in the weather. The Dust Bowl days had ended and there was a period of rainier weather. The locally significant storm events of 1948, 1950, 1954 and 1957 were an indication of this wetter period. At the end of this period came the widespread flood of 1960.

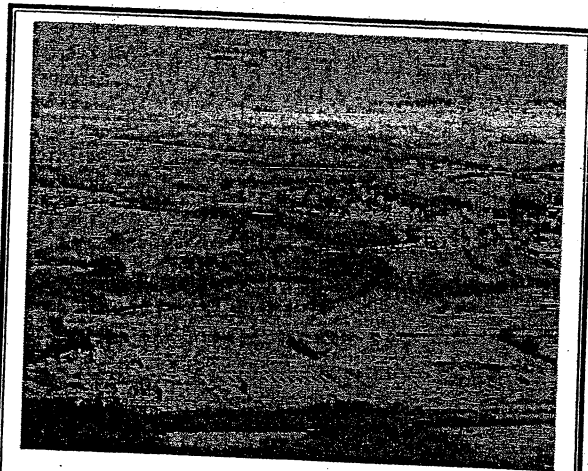
The 1960 event is still the flood of record for the Fox River and many tributaries throughout Lake County. The duration and depth of flooding was startling to everyone involved and brought initiatives to control flooding.

Many communities started regulating development to reduce the rate of runoff with stormwater management ponds and building in floodplains was discouraged. By the end of the 1970s, most communities had joined the National Flood Insurance Program and enacted regulations to better manage development in the mapped floodplains.

After a decade of little flood activity, repetitive flooding began with the 1973 flood. Floods occurred in 1974, 1976, 1979, 1982, 1985, 1986 and 1987. The 1986 flood set a record on the Des Plaines River and the 1987 event was a record on the North Branch of the Chicago River.

The 1987 flood also produced new state laws that restricted floodway development and authorized the creation of the Stormwater Management Commission.

Flooding in the 1990's has not been as bad as in the 1980's. However there were floods in 1993 and 1995. The 1993 flood was part of the "flood of the century" in the Upper Mississippi River basin which produced new Federal legislation that elevated the importance of mitigation and increased funding levels for mitigation support programs. While we cannot predict when or how high the next flood will be, we now have more tools to address its effects, if we learn from this history.



Des Plaines River Flood, 1986

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Chapter 2. Problem Identification

Lake County Watersheds	1
Methodology	4
Overview of Flooding	7
Flooding Sources	9
Flooding Impacts	14
Dollar Damage Estimates	19
Other Hazards	22
Future Flooding	23

This chapter presents Lake County's approach to identifying flood-related problems. It includes a description of the four main watersheds, a summary of the flood-related data collection effort, a description of flooding sources and a summary of the impacts of the flooding by watershed.

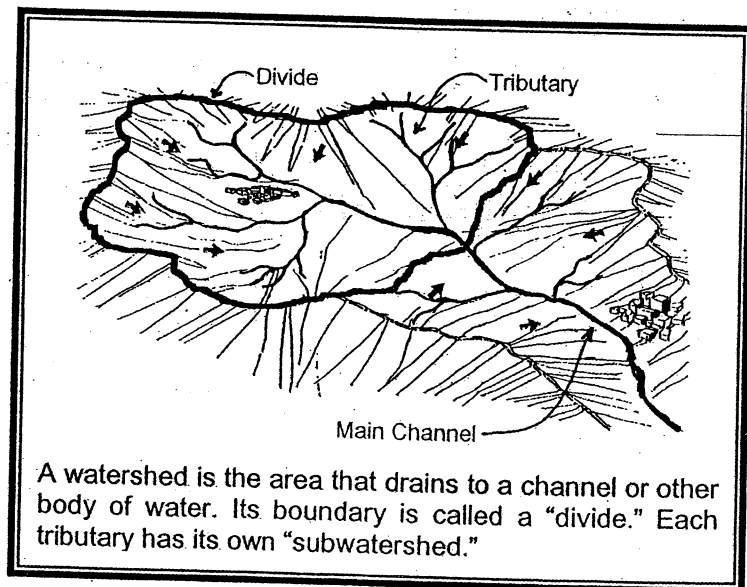
An overview of the flood-related problems identified in the county as a whole is presented on this chapter. Chapter 3 provides summary data for each of the County's 26 subwatersheds. Appendix A has more details on the several hundred problem sites that have been identified to date.

Lake County Watersheds

The term "watershed" refers to all of the area above and below the surface of the ground that flows or drains into a particular body of water.

Lake County is naturally divided into four watersheds with drainage to major waterways: the Fox, Des Plaines, and North Branch of the Chicago Rivers and Lake Michigan. Each of the four major watersheds are subdivided into 26 subwatersheds. Lake County watersheds are summarized in the table on the next page and outlined in the map on page 2-3.

Generally, the Fox and Des Plaines River watersheds are both wider and larger in terms of land surface area, while the Lake Michigan and North Branch Chicago River watersheds are long and narrow.



Lake County's Watersheds

Fox and Des Plaines Rivers

The western three-quarters of Lake County's drainage is comprised of medium size sub-watersheds that are tributary to the Fox and Des Plaines Rivers. These watersheds are wide and are not greatly affected by the direction rain storms may take. The runoff in these watersheds is slowed by storage in depressions, wetlands and the inland lakes. Floodwaters work through these storage areas as they pass downstream. This natural drainage system has the effect of detaining runoff and reducing downstream flooding, but localized flooding occurs at some of these natural storage sites.

The main stems of the Fox and Des Plaines Rivers have flood characteristics that are very different from any other area of the county. These larger rivers experience their worst floods from rain events that last a few days, or from a series of small rain events over a longer duration. The greatest flooding along the Fox and Des Plaines occurs following longer rain events. The floods of 1960 and 1986 resulted from long steady rains which eventually overwhelmed the available floodplain storage and set new flood stage records on the Fox and Des Plaines Rivers respectively.

The 1986 event resulted from 10 days of widespread steady rain. It took the Des Plaines 4 weeks to pass this floodwater. For the larger Fox River, the time to pass this flood was 6 weeks. In comparison, the smaller watershed of the Skokie River drained down to normal only a few days after the rains ended. Long-duration rain events on snow packs can also cause major flooding on the larger rivers.

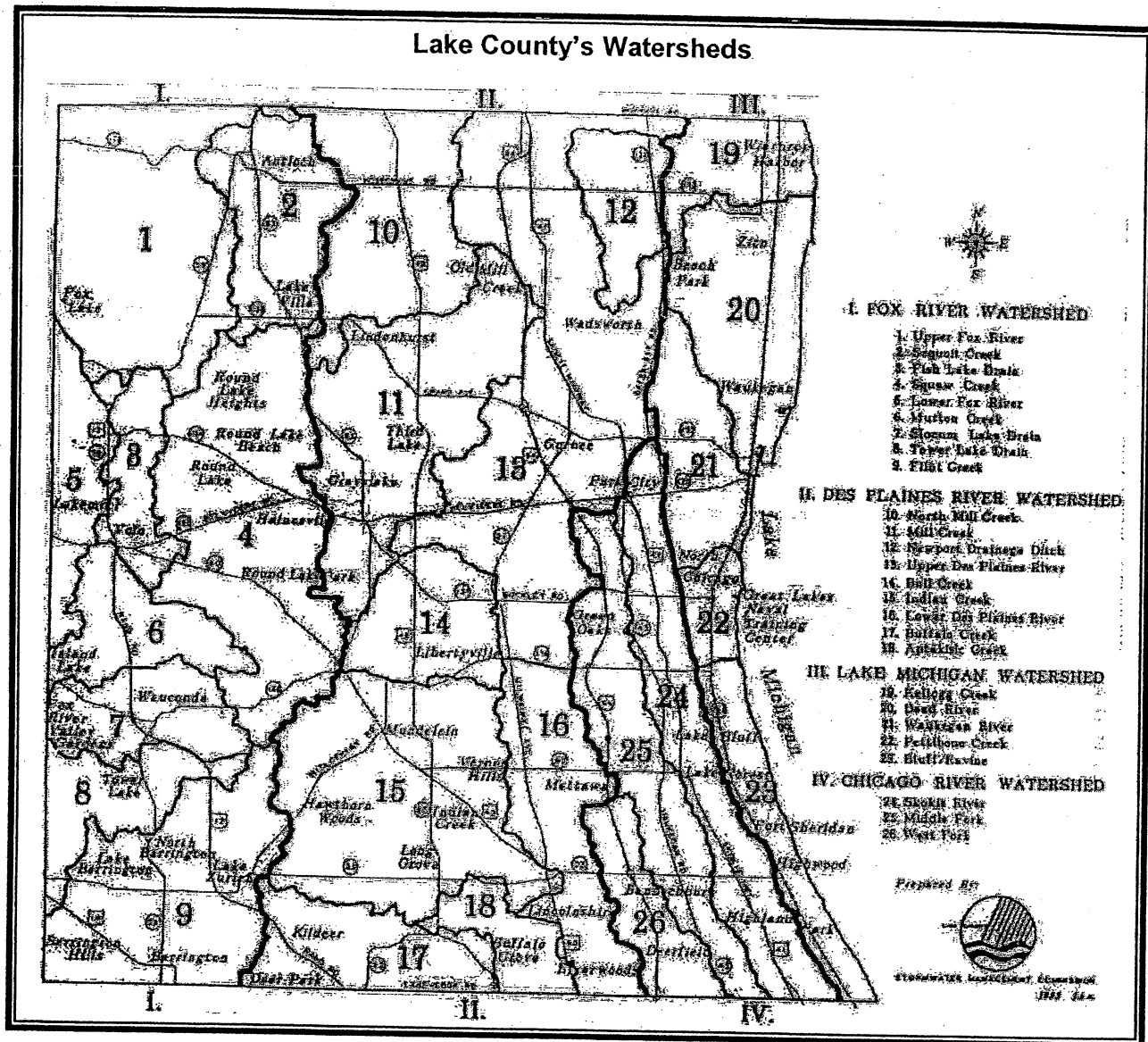
Lake Michigan

Along Lake Michigan there are several small subwatersheds dominated by urban conditions. In these watersheds, systems of storm drains deliver runoff to the ravines that drain into the lake. Intense rain events overwhelm the storm drains and can cause significant localized flooding problems that are relatively short in duration. The rapid rise and fall of water levels and velocities in the ravines have resulted in severe erosion.

North Branch Chicago River

The North Branch Chicago River watershed is noted for three long and narrow subwatersheds surrounding the 3 forks of the North Branch of the river. Floods on these long and narrow watersheds are affected by the direction taken by a storm. On the three forks, the worst flooding is caused by storms that move from north to south. The runoff moves under the storm front and concentrates as it goes downstream. Storms that pass east to west produce smaller floods, and storms that pass south to north produce the smallest floods.

The worst floods are caused by day-long rain events, but, because the watershed is so narrow, short intense rain events can also cause severe local flooding. The flood of record on the Skokie River in Highland Park was caused by a thunderstorm that rained only in the southern end of the watershed. Because of the channelization of these three forks, floodwaters usually drain away in just a few days.



Watershed characteristics

Because of their differing sizes and shapes, the watersheds can produce significantly different flood levels during the same rainfall events. Smaller watersheds and those in steeper terrain will drain faster. They have a shorter "time of concentration" for the runoff to collect and flow into the main channel. Larger and flatter watersheds have a longer time of concentration.

For example, due to the size of the watersheds, the main stems of the Fox and Des Plaines Rivers are prone to longer duration floods. The smaller watershed and subwatersheds, such as the North Branch of the Chicago River, the ravines that drain into Lake Michigan and some of the smaller tributaries of the Des Plaines and Fox Rivers, are prone to flash flooding.

The amount of runoff from a watershed and the time of concentration are also affected by urban development. The more pavements, rooftops and impervious surfaces there are, the more stormwater will run off to the

Development brings storm sewers and drainage ditches that also shorten the time of concentration. As a result more water runs off and collects faster, contributing to flash flooding in the smaller watersheds. The impact of development is discussed more in the later section on future flooding.

Methodology

Flood-related problems were identified based on an extensive data collection effort. The key steps in data collection were to compile existing sources of flood-related data, including historic flood damage information, review available flood studies/reports, and to create a "Flood Problem Areas Inventory" which identifies flood damage problem areas throughout the county.

Existing Data Sources

Past flood claims and damage reports for Lake County were collected. Sources of the data included:

- Loan applications from the Small Business Administration (SBA)
- Insurance claims from the National Flood Insurance Program (NFIP)
- Flood damage reports from Lake County Emergency Management Agency (LCEMA)
- Flood damage reports from the Red Cross
- Flood damage reports from the Illinois and Federal Emergency Management Agencies (IEMA and FEMA)
- Road flooding reports from the Lake County and Illinois Departments of Transportation
- A comprehensive flood response record for the 1993 flood from the Village of Gurnee
- Multi-county regional flood studies on major rivers
- Detailed studies for localized flood problem areas
- Flood audits for repetitive loss properties

The flood studies were conducted by agencies such as:

- U.S. Army Corps of Engineers

- Natural Resources Conservation Service NRCS (formerly the Soil Conservation Service or SCS)
- Illinois Department of Natural Resources Office of Water Resources (IDNR-OWR -formerly the Illinois Department of Transportation, Division of Water Resources)
- Lake County municipalities (including consulting engineering studies)

The scope of the collected reports and studies varied to a large degree. The completeness of the existing data varied from flood to flood and problem area to problem area. Therefore, flood damage estimates contained in the data were used only for comparison purposes. Watershed totals provided in this report should be used as a gauge for assessing the magnitude of the problem, but not as exact figures.

Appendix B includes a listing of all studies identified during the development of this plan.

Flood Problem Areas Inventory

In 1995 – 1996, the SMC conducted a flood damage inventory to identify flood problem areas. This was done with contacts and personal interviews with cities, villages, townships, home owner associations, county agencies, county board members, private organizations and individuals.

Each problem sites was identified by subwatersheds and given a sequence number. A standardized "Flood Problem Areas" information worksheet was developed for each site and pertinent information was added as it was obtained. A sample of the form is included in Appendix C.

A resident input questionnaire was also developed and distributed through community associations to gather additional information on local flooding problems. The problem area input questionnaire forms were added to the subwatershed and sequence numbering system and included in the inventory. See also Appendix C.

The problem areas were summarized in a database-spreadsheet and incorporated into the county's Geographical Information System (GIS). Over 300 identified flood problem sites were field inspected, either by SMC personnel or by community representatives.

The purpose of the field inspection was to:

- Verify problem area boundaries,
- Assess the flood problem, and
- Identify suitable mitigation solutions for the flood hazard area.

The information gathered during the field assessment was added to the problem areas spreadsheet for analysis.

The flood problem areas inventory also identified historic flooded areas to property and infrastructure. Flooding of open space and vacant land were not inventoried and mapped. While ponding in yards and other open space is a nuisance, it is not addressed in a flood hazard mitigation plan because it generally results in little damage.

The National Flood Insurance Program

The National Flood Insurance Program (NFIP), established in 1968, provides communities with Flood Insurance Rate Maps (FIRM) that depict the 100-year floodplain. The maps are used as the basis for floodplain regulations and insurance rate setting. Floodplain regulations and flood insurance is discussed in more detail in Chapter 5.

Since November 2000, Lake County has had a single county-wide FIRM. This has greatly facilitated map reading. The data are also relatively up to date, although the FIRM can be amended or revised whenever more accurate flood or ground elevation data are developed.

Of the 339 sites identified in the Flood Problem Areas inventory, 41 sites were located in mapped floodways and 185 in mapped floodplains. Forty-five percent of the identified flood problem sites were located outside of FIRM mapped floodplain boundaries. Flood problem sites located outside of mapped floodplains are not required to purchase flood insurance under the NFIP, therefore flood damage at these sites may not be reflected by NFIP claims.

Data Summaries

Flood problem areas were categorized and reviewed by watershed and subwatershed. The flood problem areas, flood damage data and recommended mitigation measures were sorted to identify trends and to determine the top priority subwatersheds for mitigation planning considerations.

This work also highlighted areas where more comprehensive flood damage information and improved delineation and mapping of flood problem sites is needed. Mapping of the flood problem areas also pointed out the need for a more refined delineation of subwatershed boundaries in some areas of the county. Many of the results of this effort are shown in Appendix A.

Overview of Flooding

Flooding is a naturally occurring event that includes both beneficial and potentially destructive outcomes. There are numerous determining factors associated with flooding. Rainfall events and the conditions within a watershed combine to create floods of varying types and severity. The problems associated with flooding, however, can be characterized in two ways:

- The source of the problem and
- The impact of flooding

The next two sections summarize the inventory's findings on sources and impacts of flooding in Lake County. The detailed information can be found for each subwatershed in Appendix A.

Determining Factors

Flooding results from excessive runoff from rain storm events and/or snow melt. In examining floods, it is important to understand the amount of runoff that is created in a watershed and the rate at which the runoff travels to drainageway, streams or rivers. Many factors affect both the amount and rate of runoff created, including:

- the intensity and duration of the rain event (i.e., how much falls over a certain period of time),
- the watershed topography (flat verses steep) ,
- the soils and amount of moisture in the soil (how much rain can soak in), and
- the land cover and the way the land is used.

We have no control over the first three factors, but what people do does affect the fourth. Impervious surfaces, such as rooftops, roads, parking lots cannot be penetrated by water, therefore all of the water that falls on these surfaces runs off. In urban areas, much of the runoff from impervious surfaces is collected by curbs, gutters or drain tiles and discharged into storm sewers or surface drains. The runoff is then delivered at the stream or river at a relatively fast rate.

Rural areas contain fewer impervious areas and runoff that is generated from impervious areas typically travels over grassy or undeveloped areas on its way to a stream or river. Runoff can be absorbed by soils along the way, therefore a smaller amount of runoff, delivered at a slower rate, reaches the stream.

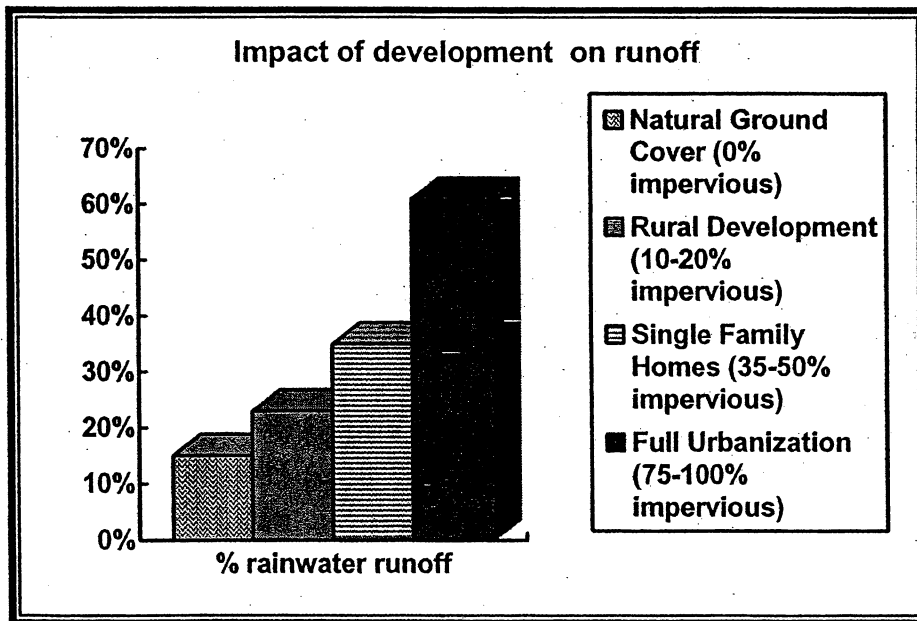
Soil permeability describes how water moves through soil. Sandy soils, for example, are very permeable and drain quickly. At the other end of the spectrum, clay soils are relatively impermeable and drain slowly.

Soils that are saturated from previous rainfall events or snowmelt cannot absorb additional water. Therefore, when rains continue after soils are saturated, rainwater either ponds in depressional areas or runs off into drainageway increasing the likelihood of flooding. Moderate rainfall on frozen ground can also result in high runoff that may result in flooding.

Land surface cover and soils vary widely throughout the county. The eastern, southeastern and south central subwatersheds are primarily urban and suburban areas that are mainly covered by the impervious surfaces of roads, rooftops and parking lots.

Western and north central Lake County watersheds and subwatersheds are more rural in nature and have a less-densely developed land surface with lower percentages of impervious surface. Vegetation and permeable soils in these areas can still absorb a large percentage of the rainfall.

The land surface of north central and northwestern Lake County is in transition from rural to suburban development. Open lands are quickly being covered with roads, buildings and parking lots that increase the collection and concentration of rainfall runoff into drainageway. Although the rural land cover still offers a good amount of absorption potential, due to expanding development, some of these areas are susceptible to future flood problems.



Many of the rural subwatersheds in Lake County have little topographic relief and include large amounts of depressional water storage in lakes and wetlands. Currently, these drainage basins have relatively low runoff rates, yet they are vulnerable to increased flooding with small increases in runoff from developing sites.

The graph shows how the percent of runoff increases as development increases.

Flood frequency

A discussion on flood hazards needs to use a uniform measure of risk. Floods come in many sizes — with varying degrees of magnitude and frequency.

For each river, engineers assign statistical probabilities to different size floods. This is done to understand what might be a common or ordinary flood for a particular river verses a less likely or a severe flood for that same river.

In order to have common standards, the NFIP, the Illinois Department of Natural Resources and the SMC have adopted the same baseline flooding probability. This is the base flood which is also known as the 100-year flood. These terms mean the same thing.

The term 100-year flood is often misconstrued. Commonly, people interpret the 100-year flood definition to mean “once every 100-years.” This is wrong! A community could have a 100-year flood two times in the same year, two years in a row, or four times over the course of 100-years. A community could also not have a 100-year flood over the course of 200 years.

Another level of risk is the 500-year flood. This is less likely to happen than the base flood, but it is the standard used for protection of critical facilities.

Flooding Sources

Excessive amounts of runoff can create flooding. Flooding can occur from one or more sources, overbank flooding, depressional ponding and sewer back-ups, plus a variety of local drainage problems. This section describes the nature of these flooding sources. The “Types of Flooding” box presents a summary of the findings in Lake County’s Flood Problem Areas inventory database.

What are the odds of a 100-year flood?

Chance of flooding over a period of time				
Time period	Flood size			
	10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10-or 25-year flood. During the proverbial 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 5% chance that the house will catch fire during the same 30-year mortgage.

Types of Flooding

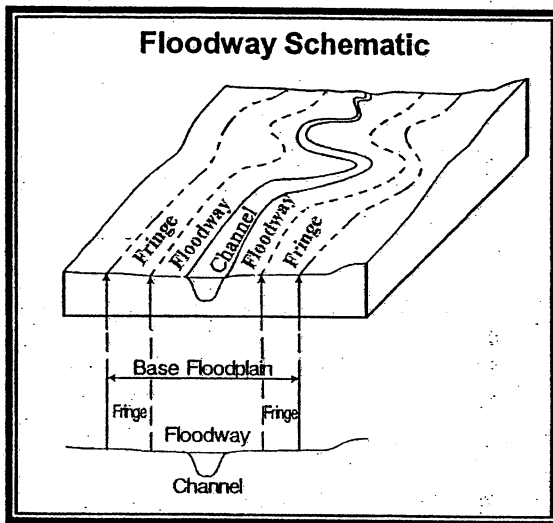
Flood Type	# of locations
Overbank flooding	127
Local drainage problems	210
Depressional flooding	113
Sewer back-ups	46
Septic problems	75
Erosion problems	9

Source: Lake County Flood Problem Areas Inventory, 1996.

The box includes the number of reported locations affected from various flooding sources. The details for each subwatershed can be found in Appendix A.

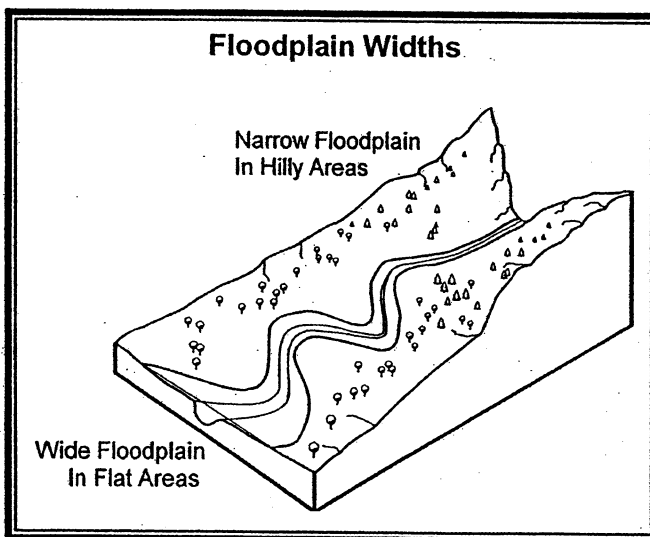
Overbank Flooding

Overbank flooding is a natural process when streams, rivers or lakes fill to capacity with runoff and floodwaters flow over the banks and into the floodplain. All streams, rivers and lakes have their own floodplains. Overbank flooding can last for a few hours on small streams (flash floods) or for weeks on the large rivers.



The floodplain contains two parts: the floodway which is next to the stream or river, and the flood fringe which is the outermost area of the floodplain. The stream uses the floodway to help convey the runoff downstream. The floodwater in the floodway flows with a velocity that can cause additional damage. The flood fringe serves as a storage area as it is typically slow moving.

When floodplains are left unobstructed by development they provide ecological diversity and water quality functions. Floodplains include a combination of rich and moist soils that produce an abundance and diversity of plants.



Floodplains also serve to filter sediments and pollutants from runoff, thereby improving water quality in streams and rivers and lakes.

The topography of the watershed and the bends and turns of the streams and rivers affect the rate that runoff can move through and out of the watershed. Lake County watersheds are gently rolling to flat with many depressions. The slope of the land from one end of the watershed to the other is minimal. It is the accumulation of runoff upstream that moves the water downstream.

The Fox and Des Plaines River channels have very mild slopes while the ravines along Lake Michigan have steep slopes. The flow of rivers with mild slopes is frequently impaired by natural and man-made restrictions.

Natural restrictions are narrows in the floodplain, beaver dams, and log jams. Man-made restrictions are floodplain fill, dams and bridges.

There is very little energy available in a river with a mild slope, so the river builds up depth until it has the energy to force its way through a restriction. This building up of depth causes the river to back up upstream of the constricted area. This backwater effect can extend for miles and water is pushed back into the floodplains.

The depth of the flooding is determined by the interaction of water entering the river from its tributaries, the amount of water going into floodplain storage and the water passing through the restriction. When the tributaries are contributing more water than the constrictions can pass, the flood stage increases and the water goes into floodplain storage.

When the tributary flow subsides below the rate passing through the constriction, water comes out of floodplain storage and the flood stage drops. The effect of constrictions and floodplain storage is to delay and attenuate the flood stages.

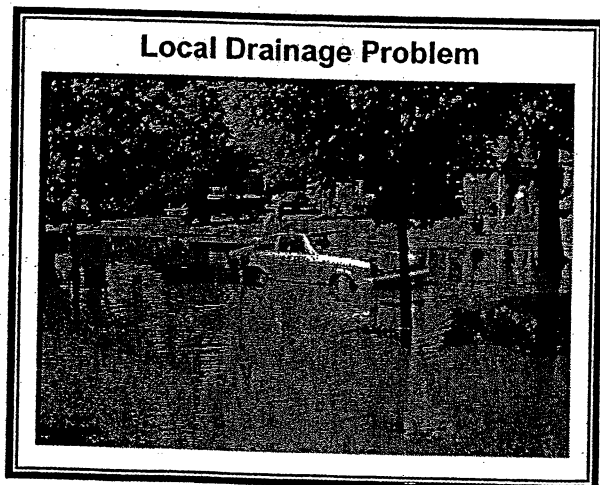
In Lake County, the depth of the floodwater in the overbank area (floodway and flood fringe) can vary from inches to several feet. Overbank flooding is most extensive along the Des Plaines River and in the Chain O' Lakes area.

As a watershed becomes developed, runoff volumes and rates increase and the frequency of overbank flooding increases. The capacity of the streams, rivers and lakes generally remains the same, therefore the floodplain is used more often to handle the increased runoff. Flow restrictions also become more significant.

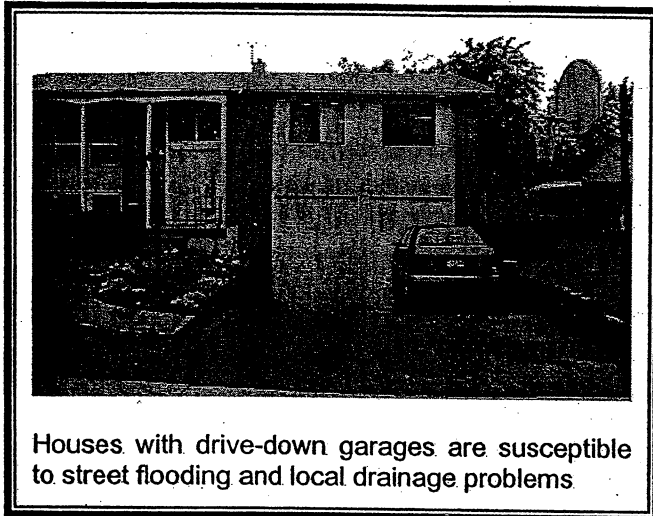
In some cases, the additional volume of runoff generated by development may result in an expansion of the historic floodplain. Preliminary results from a recent study of Des Plaines River flooding indicate that 100-year flood elevations are an average of two to three feet higher than previously mapped along the main stem of the river. These higher elevations expand the boundaries of the floodplain and bring some existing structures that were formerly considered to be outside the 100-year floodplain boundary into the floodplain.

Local Drainage Problems

Localized drainage problems can occur anywhere in Lake County. Most local drainage problems result in shallow flooding on roads, yards and, sometimes, in buildings.



In some areas, a development is actually located in a drainageway or in a depressional ponding area. Inadequately maintained drainage ditches, undersized storm sewers, and failing tile drains or storm sewers are common causes of local flooding.



Local drainage problems have the greatest damage impact on homes with drive-down basement garages and split-level homes in low lying areas. In the case of drive-down garages, water accumulating on the street finds a low driveway and fills a home's basement. Split-level homes provide easy access for surface floodwaters to enter through the ground level windows.

These drainage problems are worsened when drainageway aren't adequately maintained. Maintenance of drainage ditches and swales is often not understood

by residents who commonly block them with yard refuse or fill them in with a driveway or other barrier.

Since much of Lake County was once tiled to provide drainage for farmland, failed or inadequate drain tiles are a large problem in the developing areas of the county. Many tiles are old and were not designed to handle the stormwater loads that development produces.

The same is also true for older storm sewer systems. Most storm drains are not designed to carry more than the 10-year storm.

A similar problem occurs with road culverts. Many culverts are not designed for extreme flows. When they get blocked, or overwhelmed with stormwater, adjacent roadways flood.

Most local drainage problems are the responsibility of individual property owners and local units of government. When only a few properties are affected, local jurisdictions may voluntarily provide help to solve the problem.

Local drainage problems are fairly widely dispersed throughout the developed portions of the county. This category of flood source problems is anticipated to grow as developed areas expand in the county. Natural stormwater storage areas will be reduced and a larger burden will be placed on existing drainage systems to carry more runoff, thereby displacing runoff to adjacent properties.

Depressional flooding

Lake County has a gently rolling landscape that includes many depressional areas left from the Wisconsin Glacial Period. The common problem with development in many of these depressional areas is that there is no natural outlet for runoff. Some depressions are former wetlands that are drained with field tiles originally installed to make them farmable. In many cases the tiles are old, in disrepair, and often have limitations for handling the increased volumes of runoff that result from development.

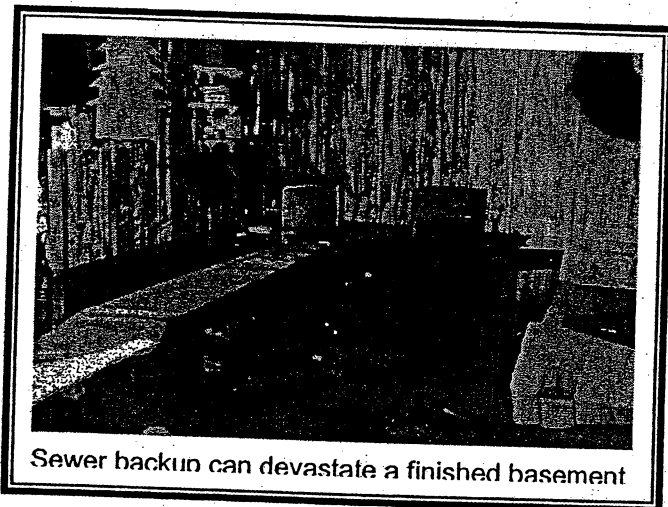
When the drainage system for depressional areas becomes overloaded, runoff will simply fill up a depression. Without an adequate outlet, the floodwater will remain until it evaporates, seeps into the ground or trickles through a tile.

Sanitary Sewer Backups

There are few combined sewers in Lake County where stormwater and wastewater discharges are transported in the same pipe system. Therefore, most of the sanitary sewer backups are caused by infiltration of stormwater into the sanitary sewer pipes, leaky manholes and inappropriate connections from residential storm drains, roof drains and sump pumps to sanitary sewer lines.

In some places excess stormwater in sanitary sewers causes manhole covers to lift off, and sewage finds its way into rivers and lakes via the storm drainage system. The contamination of surface waters with sewage degrades water quality by adding fecal coliform and excess nutrients that reduce dissolved oxygen in the water and can lead to the spread of communicable diseases. Beach closures and swimming bans are a common result.

In other areas, the combined stormwater and wastewater backs up into basements of homes and businesses through the sanitary sewer line. This type of flooding is hazardous because of the threat of communicable disease.



Flooding Impacts

While floods are natural occurrences, and while they bring benefits from a biological/ecological perspective, they can leave a wake of damage to crops, residences, businesses and public infrastructure. Floods can result in significant economic loss from disruptions to the operation of business and government.

Property Damage

Property damage includes the damage to homes, businesses and personal property. It is the most recognized impact of flooding.

"Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. As much as 90% of the damage related to natural disasters (excluding droughts) is caused by floods and associated mud and debris flows."

(US Geological Survey and National Weather Service Fact Sheet FS209-95, August, 1995).

The Flood Problem Areas inventory identified 339 flood damage problem sites. Most with property damage. While some sites may include a single structure, other sites included entire subdivisions or neighborhoods or up to 200 homes.

Property damage is discussed in more detail in the later section on dollar damage estimates.

Public Health and Safety

Homes and businesses not directly flooded may be impacted by lost utilities or flooded roads. Many septic systems fail during floods, while in other cases sewer systems may backup into basements. Both can make structures unusable for a period of time after the flood has receded and may result in public health risks.

Flooded garbage, disposal of tainted foodstuffs, disposal of damaged containers of household and commercial chemicals, and biological contaminants associated with flood waters such as e coli bacteria are examples of several additional sources of public health risk during and after a flood event.



Sediment, mold, and mildew are health hazards left by a flood.

Social and personal impacts of flooding can be significant. In addition to the loss of possessions and building damage, frequently time and energy will have to be taken from the flood victims' work to provide for clean-up and repair. Loss of personal possessions and property, combined with the stresses of clean-up and repairs, can have a significant psychological impact on flood victims.

Septic Systems

Septic system failures rarely cause damage to the structures that they serve. However septic failures can be long lasting and render structures with septic systems uninhabitable.

When a septic system becomes waterlogged, the septic flow takes the path of least resistance, which is usually straight to the surface. In addition to the home or business owner's loss of septic use until high water tables recede, the leakage of septic wastes into ground and surface waters leads to water quality problems that include the threat of communicable diseases.

Most septic system failures are found in low lying areas of unincorporated Lake County or near resort lakes that do not have sanitary sewers. Seventy-five of the 339 sites identified by the Flood Problem Areas inventory experience septic system problems due to flooding.

The rural Fox River watershed has the greatest number of septic impacts with 51 flood problem sites affected. Generally lake area homes experience the highest level of septic impact. Almost half of the Fox watershed sites that suffer from septic damage are located in the Upper Fox sub-watershed in the Chain O' Lakes area.

Transportation

Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads cause traffic snarls that extend the flood impact well beyond the flooded area. This results in missed work, extra transportation costs, and reduced commerce.

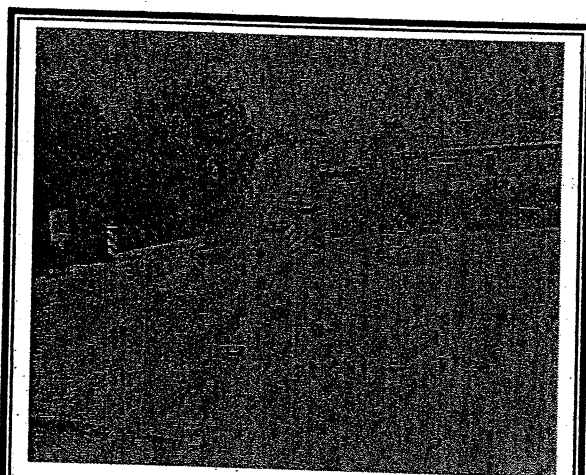
Flooding can result in hazardous driving conditions. Most of the lives lost during floods are caused when vehicles are driven or swept into floodwaters. The driving hazard is also increased due to traffic congestion and infrastructure damage to roadways and bridges during a flood and after the flood during repairs.

"Septic Failure Forces Family Out of Their Home"

Stormwater mixed with runoff from neighboring properties and septic backup made a house in the Chicago Highlands Subdivision in unincorporated Barrington uninhabitable. A mother, her daughter and their dog became sick from the septic. The mother was hospitalized for 2 days and the dog nearly died.

Because of its location in a depressional area, repair of the septic system was estimated to cost \$100,000 - 200,000....the result? Costly lawsuits were filed against the former homeowners and the Realtor who sold the house. The suit is based on the claim that full disclosure of the problem was not made at the time of the sale. In the meantime, the family of four had to rent an apartment. The septic condition prevents them from selling the house.

From: Barrington-Courier Review, "Home Smelly Home" June 8, 1995



Flooded Bridge

Several agencies have compiled information on flooded roads in Lake County. Following the 1986 flood event 37 sites were reported for road flooding or shoulder washout in the county (IEMA). Illinois Department of Transportation has identified 51 sites of pavement flooding of arterial routes for prioritization based on past flooding reports (IDOT, 1995).

In its study of flooding of the Des Plaines River, the Army Corps of Engineers describes 19 flood prone roads along the main stem of the Des Plaines in Lake County. The Flood Problem Areas inventory identified 280 sites where roads or bridges have been closed or threatened by flooding.

Public Expenditures

In addition to assistance provided to private flood victims, many local governments also suffer flood damage to public structures that can cause problems that extend beyond the doors of a particular building. Flood damage may result in the loss of a broad range of government services including: public utilities such as water distribution, sewage treatment, health support services, government administrative and operations centers, schools, and libraries.

The impacts of these losses can affect many people and may be felt for weeks, months or even years. For instance, flooded schools require repairs and cleanup that translate into lost school days, cause work disruptions for parents, and may result in the extension of the school year.

A prime example is the 1986 flood in Gurnee. The Des Plaines River flooded Gurnee Grade School and Viking Middle School in September 1986. Hundreds of students were left without classrooms. In order to continue the fall semester, creative school officials made arrangements to hold classes for 4th-8th graders at a vacant store.



Every flood costs local governments thousands of dollars in flood fighting.

When federal disasters are declared, the Federal Emergency Management Agency (FEMA) generally provides up to 75% reimbursement of eligible charges to local governments for flood support and damage through their Public Assistance program. For the 1993 flood alone, Lake County filed almost 2 million dollars in Public Assistance claims. Based on these claims, over \$1,700,000 was reimbursed to the County by the federal government.

In addition to paying for repair of public facilities, local, state and federal governments also spend dollars and person hours for flood com-

munications, emergency road and utility repair, police protection, National Guard mobilizations, fire department pumping services, sandbags, and emergency services during a flood.

After the flood significant clean-up costs may be incurred. Before the flood, governments require funds for planning, coordinating and preparing for the flood emergency and cleanup.

Erosion and Sedimentation

Flowing water has the energy to erode most of the soils in Lake County. The steeper the channel and the greater the runoff volume, the higher the flow velocity and the greater the erosion potential.

Areas prone to the most erosion damage are the bluff and ravines, lake shores, and high energy flow streams. Channelized stream reaches are less stable and more erosive than meandering sections.

Erosion in the ravines commonly threatens sanitary sewers, roads, and building foundations. Lake erosion affects boat facilities, septic systems and building foundations. Erosion on fast flowing streams may threaten bridges and roads, and may also encroach on septic systems and foundations.

All eroded sediment is eventually deposited where water flow slows: i.e., in lakes, wetlands, stream channels or floodplains. The site where sediment accumulates may be far from the eroded area. Sedimentation can block culverts and ditches, cause the loss of channel conveyance and reduce floodplain storage, thereby creating or worsening flooding problems.

In addition to exacerbating flood problems, excessive sediment loads degrade water quality and recreational assets. Sediment removal can be very expensive and may be cost prohibitive.

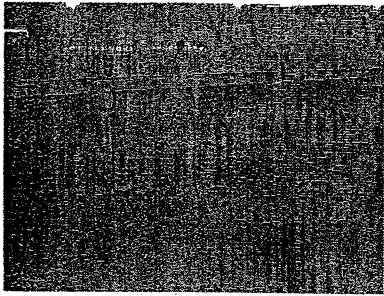
Nine sites were identified with erosion problems through the Flood Problem Area inventory. The low number of sites recorded in the inventory do not reflect the true level of erosion concerns within the county. Only those sites directly associated with flood damage areas were identified, and as mentioned previously, the site where sediment accumulates can be far from the eroded area.



Flood flows threaten property by eroding and scouring channel banks.

Hazardous Materials

A substantial amount of industry is located in Lake County. There are 320 industrial sites and two chemical manufacturing plants in the county that are classified by the Illinois Environmental Protection Agency as producers, users or storage facilities for hazardous and/or toxic chemicals (Lake County Emergency Preparedness Plan, 1994).



This floating tank could contain hazardous chemicals.

In addition, some businesses located in the floodplain stock hazardous materials that could dissolve in, or be carried away by, floodwaters. These may be common materials such as pesticides, fertilizers, paints, solvents and cleaning chemicals, or more unusual processing chemicals and stocks of dangerous water soluble products. Underground gasoline and oil tanks, landfills and illegal dumps located in floodplains may also pose a health and environmental threat in the event of a flood.

The Flood Problem Areas inventory identified two sites where warehouses storing hazardous materials are subject to flooding. The Lake County Watershed Development Ordinance prohibits the storage of hazardous materials in mapped floodplains. Unfortunately, many flood-prone areas in Lake County remain unmapped, putting adjacent and downstream properties at risk of contamination by water-borne hazardous materials.

Critical Facilities (FEMA definition)

- ✓ Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood.
- ✓ Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before during and after a flood.
- ✓ Public and private utilities that are vital to maintaining or restoring normal services to flood impacted areas before during and after a flood.
- ✓ Structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic and/or water reactive materials.

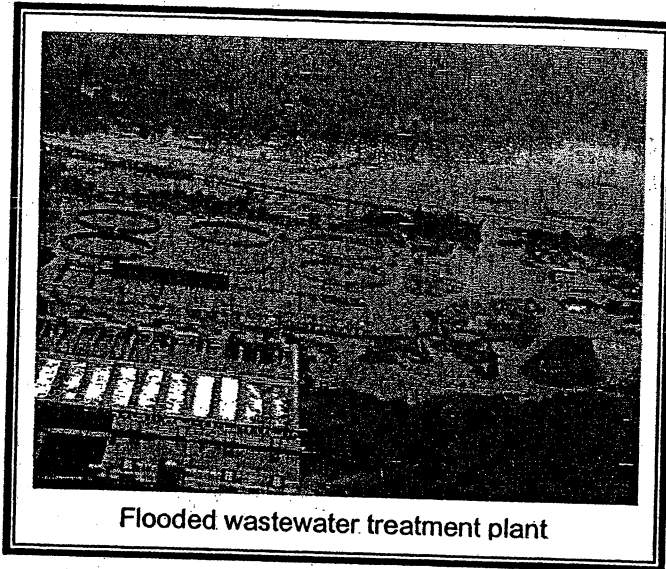
Critical Facilities

The flooding of critical facilities usually represents a loss of necessary emergency services to the community. The most common critical facilities that may be affected by flooding are emergency operations centers, police and fire stations, hospitals, nursing homes, schools, highway departments, public works facilities and utilities. Many of these facilities house staffs that are important for flood fighting and recovery.

Although the problem is not widespread, the loss of critical facility services may have significant community impact. Critical facilities are therefore a high priority for flood protection.

In addition to protecting the actual buildings, access to the facility over local roads and bridges must also be maintained for the facilities to operate effectively.

Examples of public works facilities at risk from flooding include water and wastewater treatment plants. These treatment plants are often located in floodplains, which puts them at risk during severe flood events. If a water supply becomes contaminated, water must be hauled in to the community until dependable service can be restored. If a wastewater treatment plant become flooded, there is a risk of raw sewage entering streams or rivers.



The Illinois Emergency Management Agency (IEMA) reports from the 1986 flood indicate that 21 schools, 4 police stations, 5 medical or hospital facilities, 5 government administrative buildings and 2 treatment plants were flooded in Lake County. IEMA 1993 flood reports indicate that 9 schools and 1 police station were flooded.

The Flood Problem Areas inventory identified 10 schools, 6 police and 2 fire stations, 3 public works facilities, 2 community centers and an electric substation that have either flooded, or have had access cut off due to flooding.

Dollar Damage Estimates

Methodologies and criteria for recording flood damage information are not consistent among the various agencies. Some agencies may consider only one category of flood damage or may collect information for only those sites under that particular agency's jurisdiction. The best information provides only estimates of flood damage that while useful for comparison purposes, are not accurate dollar amounts.

A second hindrance to accurate assessments of flood damage is that a number of flooding impacts are not easily quantifiable. For instance, the loss to people of time, energy and emotional well-being from flood fighting, repairs and cleanup and loss of irreplaceable personal belongings cannot be measured in dollars.

Information on flood damage was compiled from several sources including watershed or river studies that provide estimates of existing or future flood damage, and through post flood claims and reports maintained by disaster relief agencies. Although not comprehensive, these estimates

provide useful information for comparison purposes and reflect the best information available on flooding impacts.

Estimates of the economic impacts from flooding have been made in flood control feasibility studies for the Fox and Des Plaines Rivers by the US Army Corps of Engineers (Corps), and for the North Branch of the Chicago River by the Soil Conservation Service, now the Natural Resources Conservation Service (NRCS) and the Corps.

In most flood studies, damage information and estimates have not been presented by county. The flood studies are generally based on the main stem of a river that may traverse several counties.

For example, in the Fox River study, the scope of the entire study included the Fox River watershed from the Illinois state line to St. Charles, IL. Average annual residential damage were estimated to be \$1,286,900 for the entire study area, but there is no estimated damage breakout for Lake

Flood Damage Estimates			
Study Area	Agency	Date	Estimated Average Annual Flood Damage
Fox River - Chain O'Lakes area	Corps ¹	1984	\$ 119,300
North Branch Chicago - Lake/Cook	SCS ²	1974	\$2,994,700
Upper Des Plaines - Lake County	Corps ¹	1989	\$ 412,000
Upper Des Plaines - Lake County	Corps ³	1996	\$6,265,000
Northeastern IL - Lake County	SCS ²	1982	\$2,361,200

¹ US Army Corps of Engineers
² US Soil Conservation Service (Natural Resource Conservation Service)
³ US Army Corps of Engineers, Upper Des Plaines Feasibility Study - Draft report

County. Damage to commercial structures, transportation and agriculture were considered not significant.

Disaster Assistance

Disaster assistance for federally declared flood disasters is provided to Lake County property owners through the Illinois Emergency Management Agency, Small Business Administration and the National Flood Insurance Program. These agencies primarily collect information of the properties that they provided assistance.

While the number of structures affected by flooding is useful information, the estimate of dollar damage is not reliable.

Emergency Management Agencies: Flood damage information for Lake County was collected by the Illinois Emergency Management Agency (IEMA) for federally declared flood disasters. Most of the data come from local emergency managers.

The box includes flood damage reported to IEMA for the 1986 and 1993 floods. Many of the properties flooded in 1993 did not have damage estimates reported, therefore, there is a discrepancy between the number of buildings affected verses the total dollar damage when comparing the 1986 to 1993 flood.

IEMA DAMAGE ESTIMATES		
Flood Year	Estimated Damage*	Number of Buildings
1986	\$6,015,435	647
1993	\$1,197,064	1,099

Small Business Administration: The Small Business Administration (SBA) provides low interest long-term loans to repair or replace disaster related damage. The program helps homeowners, renters and businesses. Loans may also be used to refinance an existing mortgage on a damaged property and, under certain circumstances, may be used to install mitigation measures.

The SBA reports do not provide damage estimates, per se, but they do describe the numbers of homeowners, businesses, and renters that need the assistance of these loans.

SBA Figures, 1993 FLOOD			
No. of Loans	Loan Amount	Verified Damage Contents	Structure
203	\$2,495,400	\$986,800	\$2,478,100
Total Damage		\$3,464,900	

National Flood Insurance Program (NFIP): Forty-five of the municipalities in Lake County and the County of Lake currently participate in the NFIP, and all properties located in these communities are eligible to purchase flood insurance. Owners of properties located within a mapped special flood hazard area (usually the 100-year floodplain) shown on a Flood Insurance Rate Map (FIRM) are required to purchase flood insurance as a condition of receiving a federally-backed mortgage or loan.

In reality, a large percentage of Lake County buildings that should be insured for flood damage are not. This assumption is based on the estimate that less than 25% of all floodplain properties in Illinois that should be insured under NFIP actually purchase flood insurance.

Of the 339 sites identified in the Flood Problem Areas inventory, 45% are located outside of Special Flood Hazard Areas, where the purchase flood insurance is not required. Flood insurance claims are not a good basis for estimating the dollar damage in these areas, since they are likely to be uninsured.

NFIP Claims in Lake County		
	Claims since 1978	
	Number	Dollars
Municipalities	943	\$4,523,000
Unincorporated	289	\$1,310,000
Total	1,232	\$5,833,000
Figures are as of December 31, 2000		

Coverage limitations also narrow the use of NFIP claims for assessing total flood damage. Basic flood insurance with the NFIP does not cover subsurface seepage and sewer backup. Basement contents, such as furnaces and water heaters, are only covered if there is a general condition of surface flooding. The NFIP does not cover damage to finished basements, nor to property damage outside of the insured building such as driveways, fences, tool sheds and landscaping.

A final shortcoming of the use of flood insurance data is that many owners do not carry full coverage for the value of their building or its contents.

Other Hazards

Natural Hazards

In addition to flooding, Lake County is vulnerable to other natural hazards that include drought, tornado, earthquake, seiche, wildfire and severe winter storms.

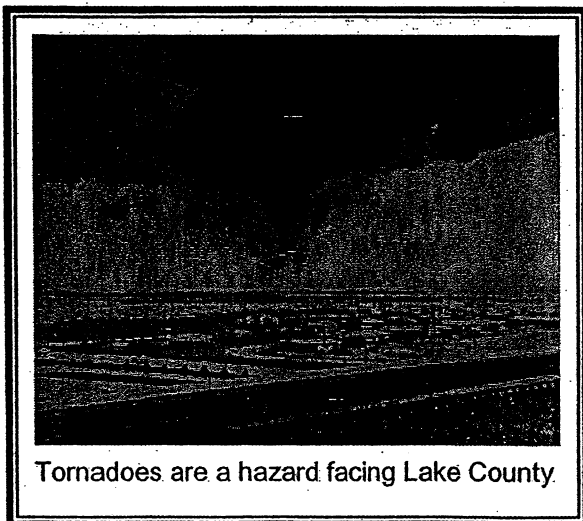
Earthquake: The county is considered to be an area of low risk for earthquakes, though small earthquakes ranging in magnitude from 3.0 to 5.0 on the Richter scale occur about once every 20 years.

The most significant of these occurred on May 26, 1909 when a 5.1 earthquake shook northern Illinois and southern Wisconsin. Minor damages are anticipated for future earthquakes, but there is the potential of fire hazards being created following the earthquake.

Storms: Next to flooding, tornadoes and winter storms are the most prevalent natural hazards. The southeast half of Lake County is in a belt of high tornado frequency. A tornado that struck Zion in May of 1996 caused enough damage to result in a federal disaster declaration for the county.

Adequate prediction methods have not been developed for tornadoes, so a good warning system is the only defense.

Severe winter storms are not uncommon in the county, these storms can impair traffic movement, but typically do not result in a disaster situation. The most significant winter storm in recent history occurred in 1978-1979 when heavy snowfall and extremely low temperatures hit the area.



Tornadoes are a hazard facing Lake County.

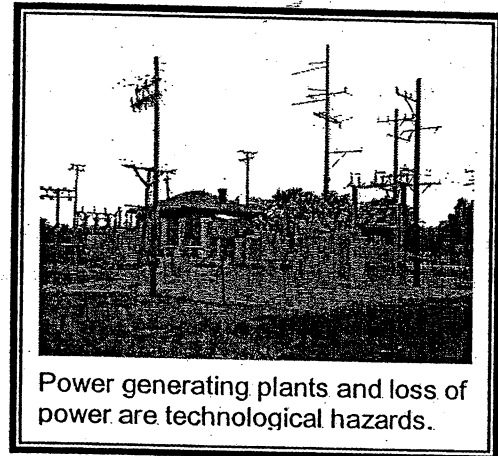
Technological hazards

Technological (or "manmade") hazards include power loss for an extended period of time,

transportation accidents, dam failure, fuel shortages, stationery or transportation-related hazardous materials incidents, nuclear facility incidents, and pollution requiring cleanup.

A substantial amount of industry is located in Lake County. Power plants and manufacturing processes that use hazardous or toxic chemicals are at risk for technological hazards. Potential hazard sources from power generation and fuel provision include a Commonwealth Edison coal-fired generating station, Zion nuclear power station, and a natural gas storage farm.

The risk of transportation-related hazards increases as the volume of traffic increases. Response to other hazards is also complicated by heavy traffic. Lake County has an elaborate transportation system that includes air, rail, water and auto traffic.



In addition to air and rail transportation, transport of freight via roadways and auto travel is also high. Many of the county's roadways are currently considered to be overburdened with traffic.

Future Flooding

Population growth

In 1990, Lake County had a population of 516,418. In addition to its residential population, the county also has a number of recreational sites that attract high seasonal populations. Four state parks attract peak seasonal daily populations of up to 20,000 and Great America Amusement Park has a peak daily population of over 50,000.

The County's population is growing and the number of visitors can be expected to grow, too. Without appropriate precautions taken, flooding and flood damage will increase.

The best available predictors of future development trends in Lake County are the forecasts for changes in population and households made by the Northeastern Illinois Planning Commission (NIPC). Preliminary NIPC forecasts for changes in population, households and employment through the year 2020 are based on 4 potential scenarios.

Overall, the average of the four alternative forecasts projects a 64% increase in households and a 53% increase in population in the county (NIPC, Preliminary Forecast Data for 2020, 1997).

Preliminary Population Forecast Data by Watershed

Watershed	1990 Population	2020* Population	% Change	1990 Households	2020* Households	% Change	Pop. 1990	Density* 2020
Fox	112,082	212,189	89%	39,154	79,827	104%	1.07	1.97
Des Plaines	178,131	295,453	66%	61,727	111,377	80%	1.37	2.28
N. Branch	66,732	92,942	39%	22,905	32,742	43%	2.07	2.89
L. Michigan	158,257	187,042	18%	49,811	60,715	22%	4.61	5.45
Totals	516,401	790,199	53%	174,013	285,677	64%		

* Population density = people/acre.

Source: Northeastern Illinois Planning Commission

Natural factors

Natural forces can also increase the flood hazard. The topography of Lake County predisposes the landscape to flooding. Excluding the bluff/ravines of the Lake Michigan watershed, most of the rest of the landscape is gently rolling, relatively flat and includes a large percentage of surface water. Water naturally collects in depressional areas, wetlands, and glacial lakes and drains to relatively shallow, low gradient rivers with broad floodplains.

Development reduces the capacity of the land to store runoff by eliminating the natural depressions, soil surface and vegetation that intercept and absorb water. Open land is replaced with impervious roofs, driveways, streets and parking lots that have the opposite effect - increasing and accelerating runoff.

In addition to the impervious surfaces, an improved drainage system is generally added to developed sites so that once stored water drains off the property quickly. These traditional developments tend to concentrate sheet flow runoff into ditches and storm sewers. Curb, gutter and storm sewer systems then collect stormwater and send this larger volume downstream to streams, rivers and lakes at a faster rate, increasing the potential for overbank flooding.

In response to the higher volume of stormwater, and the speed with which the drainage is concentrated, receiving stream and river channels become unstable, and as a result streambanks erode. Sediment transport in the channel from in-stream erosion, combined with soil erosion from construction sites, results in degraded water quality and sediment and debris blocked culverts and drainageway that in turn cause more flooding.

Impact

The impact new development has on flood damage in Lake County will largely depend upon four primary factors:

1. How well wetlands and floodplains are protected and managed;
2. How much more of the landscape is covered by impervious surface;
3. How well new development sites are designed to minimize runoff;
4. Future development trends in the Wisconsin portion of the Des Plaines and Fox watersheds.

If land continues to be developed as it has in the past with little attention given to the amount of impervious surface, new development will almost certainly result in significant increased flood damage for the county. On the other hand, if through the use of development site designs and best management practices (discussed in Chapter 5), the volume and rate of runoff from developed areas is significantly reduced, localized flood damage should be minimized.

The greatest increase in flood damage caused by new development will probably occur along the main stem of the Fox and Des Plaines Rivers and around the shorelines of developed lakes. There are several reasons why future flood damage is likely to worsen in these areas.

First, of the four Lake County watersheds, the Fox and Des Plaines have the greatest amount of land still available for development.

Second, as large river watersheds, any increase of runoff volume will have its greatest flood impact along these receiving waters. Even small increases in runoff will compound based on the sheer number of sites and acres being developed in the Fox and Des Plaines watersheds. As a result, the Fox and Des Plaines Rivers and some of the natural lakes are likely to continue experiencing increases in base flood elevation.

The magnitude of future flooding along the Fox and Des Plaines Rivers in Lake County will also depend on how well future development avoids and protects floodplains and wetlands. Planning,



Des Plaines River Floodplain Development
(1986 Flood)

regulatory authority and acquisition are the three tools that will have the strongest influence on wetlands and floodplains protection.

Communities that experience the most new development have the greatest need and responsibility to adequately plan for stormwater storage and floodplain protection. Their residents and downstream neighbors will be at the greatest risk for future flooding.

Nine hundred and thirty eight square miles of the Fox River watershed and 134 square miles of the Des Plaines watershed are located upstream of Lake County in Wisconsin. Extensive development in the upstream reaches of either will likely increase overbank flooding along the main stem reaches in Lake County.

Although Lake County has no authority over land use decisions in the Wisconsin portion of the watersheds, the County needs to remain aware of proposed developments and participate in the development planning process where possible. County plans should accommodate the likelihood of an increased volume of flow in both rivers from upstream communities, and maintain reasonable floodplain capacity in Lake County to reduce the likelihood of future flood damage.

Chapter 3. Watershed Summaries

Fox River Watershed	1
Des Plaines River Watershed.....	10
Lake Michigan Watershed	16
North Branch of Chicago River Watershed	21

This Chapter summarize the flood problems identified in the four major watersheds and 26 subwatersheds in Lake County. Information on identified flood problem sites, flood damage and areas of repetitive flooding are presented for each subwatershed. Land use information and stream characteristics presented in this section were primarily derived from the Lake County Comprehensive Stormwater Management Plan. Other sources are noted where used.

Use of flood damage data

As discussed in the previous section, flood damage data reported in this document can be used as an indicator of the severity of flood impacts, and for comparison purposes between subwatersheds, but because of program and reporting limitations, it does not separately, nor cumulatively, reflect actual flood damage for the County.

The reported dollars in the "*Flood Claims/Damage Data*" section includes only those claims and damage estimates that could be assigned to a particular watershed/subwatershed. 1,518 claims totaling \$8,797,969 were assigned to subwatersheds and summarized in these profiles. The total number of claims for Lake County is 2,806 at \$14,636,733, which leaves 1,288 claims at \$5,838,764 unassigned. Therefore, the subwatershed summary numbers are useful for comparison purposes only.

Fox River Watershed

The Fox River originates about 15 miles northwest of Milwaukee, Wisconsin and flows south and west eventually joining the Illinois River near Ottawa, Illinois. The Fox River Watershed has a total drainage area of 2,658 square miles of which 938 sq. mi. are in Wisconsin. The Fox River watershed in Lake County is

FOX RIVER WATERSHED

Drainage Area Square Miles: 165
Percent Area of Lake County: 35%

Subwatersheds: Upper Fox River
Sequoit Creek
Fish Lake Drain
Squaw Creek
Lower Fox River

Mutton Creek
Slocum Creek
Tower Creek
Flint Creek

Publicly Owned Land: 12,816 Acres

FOX RIVER WATERSHED		
Municipalities:		
Antioch		Lake Villa
Barrington		Lake Zurich
Barrington Hills		North Barrington
Fox Lake		Round Lake
Fox River Valley Gardens		Round Lake Beach
Hainesville		Round Lake Heights
Hawthorn Woods		Round Lake Park
Island Lake		Tower Lake
Lakemoor		Volo
Lake Barrington		Wauconda
Townships:		
Antioch	Ela	Lake Villa
Avon	Fremont	Wauconda
Cuba	Grant	
County Board Districts:		
1st, 3rd, 5th, 6th, 10th, 17th, 18th, 19th		
Drainage Districts:		
Squaw Creek Slocum Drain		

approximately 163 square miles (104,320 acres) which is approximately a third of the land

subwatersheds make up the Fox River Watershed in Lake County, including three subwatersheds the stem from the Fox Chain O' Lakes.

The Fox enters the northwest corner of the County in the Chain O' Lakes area, flows westward into McHenry County, and then meanders back into the southwest corner of Lake County near Fox River Valley Gardens. The river valley adjacent to Lake County is relatively flat.

Throughout the 33 mile stretch between the state line and Algonquin, the river gradient (slope) only falls about nine feet.

This nearly level landscape includes many depressional lakes and wetlands.

As a result of the mild slopes and marshy areas that provide additional depressional storage, water generally moves slowly through the watershed and the Chain O' Lakes.

Flood Damage Profile

The Flood Problem Areas Inventory identified 180 flood problem sites in the Fox River watershed.

All or part of 112 of the 180 problem sites are located in mapped floodplains, with eight of those sites located in mapped floodways. Sixty-eight of the flood problem sites are located in areas not mapped as floodplain.

Table 3-1 summarizes the number of sites affected by various types of flood problems for each of the watershed's nine subwatersheds. Table 3-1 also provides a picture of the number of site located in mapped floodplain areas by subwatershed.

Table 3-2 presents a summary of flood damage information (buildings, critical facilities and roads subject to flooding) for each subwatershed collected in the Flood Problem Areas Inventory.

From the information worksheets gathered during the Flood Problem Areas Inventory, "Flood Problem Hotspots" were identified within each subwatershed. "Hotspots" were identified based on the number of structures affected, and the frequency and severity of flood damage. The hotspots are numbered by their subwatershed number, followed by a site number that was assigned as they were identified.

Fox River Watershed Flood Problem Sites (180 Total)*		
Flood damage	Primary	Sites
type/hazard	cause	affected**
overbank flooding	72	7
local drainage problems	52	108
depressional flooding	49	2
septic problems	0	51
sewer back-up	6	26
associated erosion	1	3
* A flood problem site may include multiple buildings, roads or other infrastructure.		
** More than one type of flooding may occur at a problem site.		

Flood Problem Hot Spots

Subwatershed No. 1 - Upper Fox River – Fifty flood problem sites were identified in the inventory. Overbank flooding of developed areas along the lakeshores and channels connecting the lakes is the primary cause of flood damage. The Upper Fox subwatershed has the highest number of flood problem sites per subwatershed identified in the Flood Problem Areas inventory. Hotspots include:

- ✓ Site 1-39, the first addition to Lakeview Subdivision, located on the north side of Lake Marie is an area where approximately 20 homes and 1 road are flooded on average every two to five years (five of the homes are repetitive loss properties).
- ✓ Site 1-43, Rollins Road & Medinah, located on a channel on the south side of Fox Lake is an area where a shopping center, three to four homes (two are repetitive loss properties) and two roads flood on average every two to five years.
- ✓ Significant flood damage occurs at several sites along Mineola Bay on the south side of Fox Lake. Approximately 44 residences flood at three problem sites when the lake is up 1-1/2 feet.

Table 3-1. Fox River Watershed Flood Problem Sites

Sub-watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Type of Flood Problem						Site Location							
				Overbank Flooding	Local Drainage Problems	Depressional Flooding	Septic Problems	Sewer Back-up	Erosion	Flood-plain	Floodway	Outside Flood-plain					
1	Upper Fox River	32.7	50														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			36	7	7									45	0	5
2	Sequoit Creek	15.3	12														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			1	4	6		1							6	2	6
3	Fish Lake Drain	8.4	12														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			5	2	2		2	1						9	1	3
4	Squaw Creek	38.4	44														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			13	9	19		3							23	4	21
5	Lower Fox River	9.5	8														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			8	1										7	0	1
6	Mutton Creek	10.9	3														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			1	1	1			5						2	0	1
7	Slocum Creek	11.0	10														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			2	5	3									8	1	2
8	Tower Lake Drain	10.2	19														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			2	12	5									6	0	13
9	Flint Creek	27.6	22														
	Primary Cause of Flood Problem: Number of Sites Affected By:**			3	12	7									6	0	16
Totals:																	
								</									

Table 3-2. Fox River Watershed Flood Damage Data

Sub-Watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Estimate of Buildings Subject to Flooding	Critical Facilities Subject to Flooding or Closure	Roads or Bridges Closed or Threatened by Flooding	Repetitive Loss Properties
1	Upper Fox River	32.7	50	500-900	2	28	30
2	Sequoia Creek	15.3	12	40-80	1	5	
3	Fish Lake Drain	8.4	12	75-145		5	
4	Squaw Creek	38.4	44	700-760	4	41	11
5	Lower Fox River	9.5	8	265-470		9	6
6	Mutton Creek	10.9	3	8-15		3	1
7	Slocum Creek	11.0	10	34-40		18	
8	Tower Lake Drain	10.2	19	80-155		23	
9	Flint Creek	27.6	22	35-60	1	14	3
Totals:		163	180	1800-2600	8	146	51

- ✓ Fox River Springs located along the Fox River north of Chain O'Lakes State Park is one of the first areas to flood resulting in damage to 30-40 residences.
- ✓ Overbank flooding causes damage to approximately 30 homes in Chain Oaks Subdivision and four to five resorts located along the channel that drains from Channel Lake to Lake Marie. Septic failure is a significant problem for the resorts.

Subwatershed No. 2 - Sequoit Creek - Much of the information for the background description and land use for this subwatershed comes from the Sequoit Creek Stream Condition Report, December 1992.

Twelve flood problem sites were identified in the inventory. Hot spots include:

- ✓ Depressional flooding causes problems on the north and southeast sides of East Loon Lake where residential developments have been built in wetland areas. Approximately 50 homes are affected by flooding on the north side. Both of these flood problem sites also have local drainage problems.
- ✓ A substantial area along Petite Lake Road on the east and west side of Illinois Route 83 north of Cedar Lake floods. Flooding encroaches on the buildings on the east side and floods the road.
- ✓ An area of sewer backup affects six to twelve homes in Oakwood Knolls subdivision north of North Avenue.

Subwatershed No. 3 - Fish Lake Drain - Twelve flood problem sites, all located in the northern half of the subwatershed, were identified in the inventory. Hot spots include:

- ✓ Knollwood subdivision on the northwest corner of Duck Lake. Overbank and depressional area flooding cause the greatest problems affecting approximately 40 residences. Four roads closed due to flooding requires rowboat access. Secondary problem is overflow of sanitary sewer into Duck Lake.
- ✓ Wildwood Subdivision located on the northwest shore of Duck Lake. Combination of overbank and depressional flooding and erosion is affecting 12 residences and resulting in erosion of shoulder of Route 59.
- ✓ Site 3-08 identified east and southeast of the lake is situated in a low, marshy area subject to overbank flooding and poor local drainage. Erosion is a secondary damage factor along the drain into the lake.

- ✓ Depressional flooding and poor drainage affect approximately 20 residences at Site 3-07 north of Rollins and east of Wilson Roads. Sewer back-up is a secondary problem.

Subwatershed No. 4 - Squaw Creek – Forty-four flood problem sites were identified in the inventory. Flood hotspots are concentrated in the developed areas around Round Lake, Round Lake Drain and Long Lake. Overbank flooding predominate cause of flood problems along most of Round Lake Drain and its tributaries, and depressional flooding is a significant problem in Round Lake Beach. Hot spots include:

- ✓ Site 4-14 located on the southwest corner of Rollins and Hainesville Roads is an area where approximately 150 homes and three roads flood about every two to five years. Sewer backup is a secondary problem in this area.
- ✓ Site 4-17 located along Sunset and Meadow Brook Drives in Round Lake Beach is an area where 84 homes and two roads flood about every two to five years.
- ✓ Site 4-7 located north of Rollins Road in Round Lake Heights is an area where eleven homes, one major road, public works and police station flood about every one to two years.
- ✓ Site 4-15 located in Round Lake Beach along Round Lake Drain is an area where 79 homes including one repetitive loss property, and three roads flood about every two to five years.
- ✓ Site 4-10 located in Round Lake Park west of Cranberry Bog is an area where 26 homes flood about every five to ten years.

Subwatershed No. 5 - Lower Fox River - Eight flood problem sites were identified in the inventory, all are the result of overbank flooding from Pistakee and its channels. Although the overall number of flood problem sites identified in this subwatershed is low relative to others, several of the sites experience significant flood damage. Hot spots include:

- ✓ Site 5-1 located on Pistakee Lake at Myer's Bay is an area where 18 homes, including two repetitive loss properties, and two roads flood more than once a year. The homes are resort homes built in the 1930s & 40s. Septic failure with associated pollution and health risks is common in this area.
- ✓ Site 5-4 located on Eagle Point in Fox Lake is an area where 208 homes, including four repetitive loss properties, and four roads flood whenever Fox Lake raises 1-1.5 inches. Approximately 30-40 homes

at Eagle Point are situated below the 100-year flood elevation and are affected by chronic flooding.

Subwatershed No. 6 - Mutton Creek - Much of the information for the background description and land use for this subwatershed comes from the Mutton Creek Watershed Management Plan, 1994.

The inventory identified three problem sites in the Mutton Creek subwatershed. No areas of significant flood damage were found.

Subwatershed No. 7 - Slocum Lake Drain - Ten flood problem sites were identified in the inventory. Hot spots include:

- ✓ Site 7-1 located in Williams Park on the south side of Slocum Lake is a residential development, begun in 1926, is located on a peat bog. About 40 homes are located in the regulatory floodplain and approximately 13 homes, including two repetitive loss properties and three roads, flood every two to five years. Flooding results from lake overflow and the subdivision's depressional location. Mitigation efforts include a levee constructed along the lake located adjacent to Williams Park and a voluntary buyout program.
- ✓ Site 7-4, Lakeview Villa subdivision in Wauconda has 6-7 homes and two roads that get flooded.
- ✓ Site 7-5, Hubbard Woods in Wauconda has six homes that flood due to inadequate drainage. Flooding also closes two roads and causes sewer backup.

Subwatershed No. 8 - Tower Lake Drain - Nineteen flood problem sites were identified in the inventory. Eight flood problem sites were identified along the Fox River, affecting approximately 80 homes. Hot spots include:

- ✓ Site 8-2, approximately 24 residences at Normandy Point are subject to a combination of depressional, poor drainage and overbank flooding and septic failure every three to four years. Several roads have been closed during flood occurrences.
- ✓ Site 8-17, Frisch's Subdivision is built on land that is two feet higher than the Fox River. Approximately 30 residences are subject to overbank flooding every two to four years. Septic failure and road closures also occur during floods. There is one repetitive loss property at this site.
- ✓ Site 8-3 in River Glen Subdivision experiences the most frequent flooding in the Fox River area due to poor drainage. Three to six

homes are flooded once or twice a year. Flooding also results in local road closure.

Subwatershed No. 9 - Flint Creek- Much of the information for the background description and land use for this subwatershed comes from the Flint Creek Watershed Management Plan, July 1994.

Twenty-two flood problem sites were identified in the inventory. Most of the flooding problems identified in the inventory involve flooded roads or yards. Hot spots include:

- ✓ Site 9-4 on Old Barrington Road is a single repetitive loss property that is located in a depressional area with poor drainage.
- ✓ Site 9-13 between Miller and North Crest in Lake Zurich includes approximately 20 homes affected by basement flooding as a result of poor local drainage.
- ✓ Site 9-18 is the police and fire station in Barrington, which is a critical facility that has historically experienced basement flooding due to a low foundation and inadequate storm sewer.

Des Plaines River Watershed

Much of the information for the description and land use for this watershed comes from the Lake County Comprehensive Stormwater Management Plan.

The Des Plaines River originates in Racine and Kenosha Counties in Wisconsin flowing south into Illinois. The river enters Illinois near unincorporated Russell continuing in its southward flow through a wide, flat river valley past the communities of Wadsworth, Gurnee, Libertyville, Mettawa, Half Day, Lincolnshire and Riverwoods in Lake County. The Des Plaines flows south from Lake County through urban Cook County where it heads in a southwest direction through DuPage and Will Counties to its confluence with the Illinois River near Morris, Illinois.

DES PLAINES RIVER WATERSHED

Drainage Area in Lake County: 202 square miles
Percent Area of Lake County: 42%

Subwatersheds:	North Mill Creek	Indian Creek
	Mill Creek	Lower Des Plaines
	Newport Drain	Buffalo Creek
	Upper Des Plaines	Aptakisic Creek
	Bull Creek	

Publicly Owned Land: 11,730 acres
Wetlands: 20,595 acres

The Des Plaines watershed in Lake County drains an area of approximately 202 square miles or 129,577 acres. It is the largest of the county's four major watersheds. The topography of the watershed is dominated by a gently rolling landscape with numerous wet marshy areas. The Des Plaines watershed in the county is divided into nine subwatersheds.

There are seven major tributaries that drain to the river. All of these tributaries, excluding Newport Drain, flow from the west to east to join the Des Plaines.

Flood Damage Profile

The Flood Problem Areas Inventory identified 89 flood problem sites in the Des Plaines watershed.

All or part of 41 of the 89 problem sites are located in mapped floodplains, with 18 of those sites located in mapped floodways. 48 of the flood problem sites are located in areas not mapped as floodplain.

Table 3-3 summarizes the number of sites affected by various types of flood problems for each of the watershed's nine subwatersheds. Table 3-3 also provides a picture of the number of site located in mapped floodplain areas by subwatershed.

Table 3-4 presents a summary of flood damage information (buildings, critical facilities and roads subject to flooding) for each subwatershed collected in the Flood Problem Areas Inventory. Table 3-4 also provides a snapshot of land use in the subwatershed (NIPC 1990 Land Use), which can be used as an indicator or potential future flood problems.

From the information worksheets gathered during the Flood Problem Areas Inventory, "Flood Problem Hotspots" were identified within each subwatershed. "Hotspots" were identified based on the number of structures affected, and the frequency and severity of flood damage. The hotspots are numbered by their subwatershed number, followed by a site number that was assigned as they were identified.

Flood Problem Hot Spots

Subwatershed No. 10- North Mill Creek - The Flood Problem Areas inventory identified only two flood problem sites in the North Mill Creek subwatershed, and no hotspots.

Subwatershed No. 11 – Mill Creek – Nineteen flood problem sites were identified in the inventory.

Hotspots include:

- ✓ Site 11-15 along Behm Drive in Grayslake includes approximately 15 homes that flooded in 1986-87. Mostly back yards and road flood in smaller rain events.

Des Plaines River Watershed Flood Problem Sites (89 total)*

<u>Flood problem type/hazard</u>	<u>Primary cause</u>	<u>Sites</u>
<u>affected**</u>		
overbank flooding	28	28
local drainage problems	29	56
depressional flooding	29	34
septic problems	1	4
sewer back-up		12
erosion		3

* A flood problem site may include multiple buildings, roads or other infrastructure.

** More than one type of flooding may occur at a problem site.

DES PLAINES RIVER WATERSHED

Municipalities:

Antioch	Indian Creek	Mundelein
Beach Park	Kildeer	Old Mill Creek
Buffalo Grove	Lake Villa	Riverwoods
Deer Park	Lake Zurich	Round Lake Beach
Grayslake	Libertyville	Round Lake Park
Green Oaks	Lincolnshire	Third Lake
Gurnee	Lindenhurst	Vernon Hills
Hainesville	Long Grove	Wadsworth
Hawthorn Woods	Mettawa	Wheeling

Townships:

Antioch	Lake Villa	Warren
Avon	Libertyville	Waukegan
Benton	Newport	West Deerfield
Ela	Vernon	Zion
Freemont		

County Board Districts:

2nd, 3rd, 6th, 7th, 8th, 10th, 11th, 13th, 15th, 18th, 19th, 20th, 21st

Drainage Districts:

Avon-Fremont Grubb School

Table 3-3. Des Plaines River Watershed Flood Problem Sites

Sub-watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Type of Flood Problem						Site Location		
				Over-bank Flooding	Local Drainage Problems	Depression at Flooding	Septic Problems	Sewer Back-up	Erosion	Flood-plain	Floodway	Outside Flood-plain
10	North Mill Creek	21.5	2									2
	Primary Cause of Flood Problem: Number of Sites Affected By:**				1	1						
11	Mill Creek	31.0	19							4		15
	Primary Cause of Flood Problem: Number of Sites Affected By:**				9	10	1	1				
12	Newport Drain	8.4	7								2	3
	Primary Cause of Flood Problem: Number of Sites Affected By:**			2	1	4				4		
13	Upper Des Plaines	53.0	29									
	Primary Cause of Flood Problem: Number of Sites Affected By:**			13	4	11		1		14	7	15
14	Bull Creek	12.3	1									
	Primary Cause of Flood Problem: Number of Sites Affected By:**			1	1	1	1		1	1		
15	Indian Creek	37.7	15								3	8
	Primary Cause of Flood Problem: Number of Sites Affected By:**			3	11	1				7		
16	Lower Des Plaines	18.2	10									
	Primary Cause of Flood Problem: Number of Sites Affected By:**			9	1					9	5	1
17	Buffalo Creek	13.7	4									4
	Primary Cause of Flood Problem: Number of Sites Affected By:**				3	1						
18	Aptakisic Creek	6.3	2								1	
	Primary Cause of Flood Problem: Number of Sites Affected By:**			1	1					2		
Totals:		202	89							41	18	48

*A flood problem site may include multiple buildings, roads or other infrastructure.
 ** More than one type of flooding may occur at a problem site.

**Table 3-4. Des Plaines River Watershed
Flood Damage Data**

Sub- Watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Estimate of Buildings Subject to Flooding	Critical Facilities Subject to Flooding or Closure	Roads or Bridges Closed or Threatened by Flooding	Repetitive Loss Properties
10	North Mill Creek	21.5	2	5			1
11	Mill Creek	31.0	19	55-70		12	2
12	Newport Drain	8.4	7	60-110		5	
13	Upper Des Plaines	53.0	29	260-345	1	30	5
14	Bull Creek	12.3	1	1-3			
15	Indian Creek	37.7	15	70-80		12	1
16	Lower Des Plaines	18.2	10	65-120		3	5
17	Buffalo Creek	13.7	4	2-4		5	1
18	Aptakisic Creek	6.3	2	5-7			
	Totals:	202	89	530-750	1	67	15

/acant land represents wetland, forest and grassland areas.

Subwatershed No. 12- Newport Drain - Seven flood problem sites were identified in the inventory. Depressional flooding is the most common cause of flooding in the watershed, but relatively few buildings are affected at these flood problem sites.

Subwatershed No. 13 – Upper Des Plaines – Twenty-nine flood problem sites were identified in the inventory. Hotspots include:

- ✓ Site 13-3 North Libertyville Estates has 87 homes, including three repetitive loss properties and four roads that have historically flooded every one to two years. Septic system failure is a secondary hazard. A levee system constructed along the river in 1997-98 should protect this area from floods up to a 40-year event.
- ✓ Site 13-18 located east of the Des Plaines River in Gurnee is a large area of overbank flooding that affects 26 homes and several businesses including one repetitive loss property. Two schools and one critical facility are also subject to flood damage or closure.
- ✓ Site 13-17 covers 70-100 homes scattered in an area of Gurnee subject to sanitary sewer backup in basements from flash flooding. Remedial plans include a new lift station.
- ✓ Site 13-28 along Russell Road includes 34 buildings that experience basement and first floor flooding from river overbanking almost every spring.

Subwatershed No. 14 – Bull Creek - One flood problem site was identified in the inventory. No hotspots were identified.

Subwatershed No. 15 – Indian Creek - Fifteen flood problem sites were identified in the inventory. Hotspots include:

- ✓ Site 15-3 in Forest Lake Subdivision has had up to 40 homes at risk of flooding three to six times per year and three roads have been closed. Several projects to improve local drainage have increased the level of flood protection up to a 7-inch rain event.

Subwatershed No. 16 – Lower Des Plaines - Ten flood problem sites were identified in the inventory. Overbank flooding is the primary cause of flood problems in this basin. A recent hydrologic and hydraulic model done by the IDNR Office of Water Resources for the Corps of Engineers feasibility study on the Des Plaines indicates that base flood elevations have risen by one to four feet along the main stem since the last model was done in the 1970s. Hotspots include:

- ✓ Site 16-1 along Elm Road in Vernon Township has seven to twelve homes that have wells and septic fields flooded one to three times a year. This site includes two repetitive loss properties, and one major road that floods more than once per year. Flooding frequency has increased.
- ✓ Site 16-4 in Lincolnshire has 31 homes that flood including 1 repetitive loss property. A portion of the site is affected one time per year. 53 homes are at risk in a 100-year flood event. One road floods every one to two years. Floodwaters percolate through a levee and storm sewers back up if the river level gets high enough.

Subwatershed No. 17 – Buffalo Creek - Four flood problem sites were identified in the inventory. Hotspots include:

- ✓ Site 7-2 is in Sturm Subdivision where seven properties are flooded one or two times per year and access is lost for 17 homes when the road floods. Several phases of a multi-year project that included the purchase and removal of the two most floodprone homes and providing more detention storage has greatly reduced flood damage at this location.

Subwatershed Number 18 – Aptakisic Creek - The Flood Problem Areas inventory identified 2 flood problem sites in the Aptakisic subwatershed. The most significant flood damage is due to overbank flooding from Aptakisic due to backup of excess water from the Des Plaines River. No hotspots were identified.

Lake Michigan Watershed

Most of the information for the description and land use for this watershed comes from the Lake Michigan Watershed Inventory, April, 1993.

LAKE MICHIGAN WATERSHED

Drainage Area in Lake County: 54 square miles

Percent Area of Lake County: 12%

Subwatersheds:

Kellogg Creek	Dead River
Waukegan River	Pettibone Creek
Bluff/Ravine	

Publicly Owned Land: 5,215 acres

Wetlands: 12,532 acres

The Lake Michigan watershed in Lake County runs north-south following the shoreline of Lake Michigan. The boundary of the watershed approximately follows Green Bay Road at its western limit. The watershed is long and narrow with numerous short tributaries that drain east to the lake.

From these tributaries, the waters of Lake Michigan flow into Lake Huron and on

through Lakes Erie and Ontario into the St. Lawrence seaway and the Atlantic Ocean. The Lake Michigan watershed is the only Lake County watershed that drains to a potable water source. Approximately 80% of Lake County households rely on Lake Michigan for water (County Framework Plan).

The southern portion of the watershed is dominated by steep bluffs and ravines and is generally well-drained, while the northern half is level to gently rolling with wet marshy areas. The entire Lake Michigan watershed in the county is divided into 5 subwatersheds with numerous small tributary basins particularly in the bluff/ravine area.

LAKE MICHIGAN WATERSHED

Municipalities:

Beach Park	Lake Bluff	Winthrop Harbor
Highwood	Lake Forest	Waukegan
Highland Park	North Chicago	Zion

Townships:

Benton	Waukegan
Deerfield	West Deerfield
Shields	Zion

County Districts:

2nd, 4th, 8th, 9th, 11th, 12th, 13th, 14th, 16th, 22nd, 23rd

Drainage Districts:

Beach Park

Depressional storage in the watershed includes a total of approximately 7,252 acres of wetlands (Lake County Wetland Inventory). Most of the remaining wetlands (5,280 acres or 70%) occur in the flatter landscape of the northern half of the watershed.

Flood Damage Profile

The Flood Problem Areas Inventory identified 35 flood problem sites in the Lake Michigan watershed. The primary cause of the largest number of flood problems in the watershed can be attributed to poor local drainage.

All or part of seven of the 35 problem sites are located in mapped floodplains with two sites are in mapped floodways. Twenty-eight of the flood problem sites are located in areas not mapped as floodplain.

Table 3-5 summarizes the number of sites affected by various types of flood problems for each of the watershed's nine subwatersheds. Table 3-5 also provides a picture of the number of site located in mapped floodplain areas by subwatershed.

Lake Michigan Watershed Flood Problem Sites (35 total)*		
Flood problem type/hazard	Primary cause	Sites affected**
overbank flooding	3	3
local drainage problems	20	26
depressional flooding	5	9
septic problems		2
sewer back-up	5	12
erosion	2	3
*A flood problem site may include multiple buildings, roads or other infrastructure.		
** More than one type of flooding may occur at a problem site.		

Table 3-6 presents a summary of flood damage information (buildings, critical facilities and roads subject to flooding) for each subwatershed collected in the Flood Problem Areas Inventory.

From the information worksheets gathered during the Flood Problem Areas Inventory, "Flood Problem Hotspots" were identified within each subwatershed. "Hotspots" were identified based on the number of structures affected, and the frequency and severity of flood damage. The hotspots are numbered by their subwatershed number, followed by a site number that was assigned as they were identified.

Flood Problem Hot Spots

Subwatershed No. 19 - Kellogg Creek – One flood problem site was identified in the inventory The site is the Zion Industrial Park which is subject to overbank flooding from the South Branch of Kellogg Creek. Lack of upstream detention and poorly defined drainage ditches are a secondary contributor to flooding at the site.

Subwatershed No. 20 - Dead River -

Twelve flood problem sites were identified in the inventory. Flooding due to poor local drainage is the primary stormwater management problem in the watershed. Hot spots include:

- ✓ Site 20-3 in Beach Park has approximately 12 homes that flood and experience sewer backup due to inadequate pipes. Four roads are subject to closure.
- ✓ Site 20-6 Lake County Gardens, located west of Lyon's Forest Preserve in Waukegan, is a subdivision of 450 homes built on peaty soils. Sewer backup causes basement flooding approximately twice a year following any substantial rainfall.

**Table 3-5. Lake Michigan Watershed
Flood Problem Sites**

Sub-watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Type of Flood Problem						Site Location		
				Overbank Flooding	Local Drainage Problems	Depressional Flooding	Septic Problems	Sewer Back-up	Erosion	Flood-plain	Floodway	Outside Flood-plain
19	Kellogg Creek	8.9	1							1		
	Primary Cause of Flood Problem:			1								
	Number of Sites Affected By:**			1								
20	Dead River	18.7	12							4	2	8
	Primary Cause of Flood Problem:				7	1		4				
	Number of Sites Affected By:**				7	2	2	6				
21	Waukegan River	17.6	13							1		12
	Primary Cause of Flood Problem:			1	9	2 *		1				
	Number of Sites Affected By:**			1	12	3		4	1			
22	Pettibone Creek	4.2	4							1		3
	Primary Cause of Flood Problem:			1	1	1			1			
	Number of Sites Affected By:**			1	3	1		2	1			
23	Bluff/Ravine	9.9	5									5
	Primary Cause of Flood Problem:				3	1			1			
	Number of Sites Affected By:**				3	2			1			
	Totals:	54	35							7	2	28

*A flood problem site may include multiple buildings, roads or other infrastructure.

** More than one type of flooding may occur at a problem site.

- ✓ Site 20-8 in the City of Zion is a neighborhood off of 23rd Street where 30-50 homes are subject to sewer backup when the ground is saturated.
- ✓ Site 20-9 is also a neighborhood off of 23rd Street in Zion where 20-30 homes are flooded from sewer backup mainly in the spring when the ground is saturated.
- ✓ Site 20-10 in south Zion off of 33rd Street is a neighborhood where approximately 40 homes are affected by sewer backup when the ground is saturated in the spring.

Subwatershed No. 21 - Waukegan River -

Thirteen flood problem sites were identified in the inventory. Much of Waukegan's infrastructure is old and in some areas under-sized for the amount of runoff it receives. Hot spots include:

- ✓ Site 22-2 is a ravine area located on the Great Lakes Naval Base where severe erosion threatens several buildings and a gravel road. Major damage has occurred three times in 16 years and the road washes over two times per year.
- ✓ Site 22-4 is a large area of neighborhoods in North Chicago in the area of 18th and Jackson Streets where approximately 20-30 homes are subject to flooding and sewer backup due to their depressional location and poor local drainage. Storm sewers and sanitary sewers meet at this junction. Storm sewers in this area are connected to the Waukegan subwatershed.

Subwatershed No. 22 - Pettibone Creek

Four flood problem sites were identified in the inventory. Hot spots include:

- ✓ Site 22-4 located in the vicinity of Jackson and 18th Streets in North Chicago floods

Table 3-6. Lake Michigan Watershed Flood Damage Data

Sub-Watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Estimate of Buildings Subject to Flooding	Critical Facilities Subject to Flooding or Closure	Roads or Bridges Closed or Threatened by Flooding	Repetitive Loss Properties
19	Kellogg Creek	8.9	1	1		1	
20	Dead River	18.7	12	280-550		11	
21	Waukegan Creek	17.6	13	25-35	2	6	
22	Pettibone Creek	4.2	4	25-35		6	
23	Bluff/Ravine	9.9	5	25-40	2	5	1
	Totals:	54	35	355-660	4	29	1

approximately two times per year as a result of its depressional location combined with poor drainage. 20-30 homes and two schools are affected in addition to the closure of Jackson Street. Sewer backup is a secondary flood cause. Both storm and sanitary sewers meet in this intersection.

Subwatershed No. 23 – Bluff/Ravine -

Five flood problem sites were identified in the inventory. Poor local drainage is the primary cause. Hot spots include:

- √ Site 23-5 centered at Western Avenue and Illinois and College Roads in Lake Forest includes a commercial area and ten residences that are subject to flooding approximately once per year. Western and Illinois are closed by flooding.
- √ Site 23-1 at Western Avenue and Frost Place includes a repetitive loss property. The area floods three to four times per year resulting in the closure of Western Avenue.

North Branch of Chicago River Watershed

The North Branch of the Chicago River is a tributary of the Des Plaines River that originates with three tributaries in Lake County. The North Branch flows south to its confluence with the North Shore Channel, then on to the Chicago Sanitary and Ship Canal where it is diverted westward to the Des Plaines.

The Des Plaines, a tributary of the Illinois River, flows on to the Mississippi. The Chicago River originally flowed into Lake Michigan. Due to pollution and health problems that arose from the city's sewage discharge into the river, the flow of the river was diverted from Lake Michigan, the city's water source, into the Mississippi River basin in 1871.

The North Branch of the Chicago River in Lake and Cook Counties covers an area of 102 square miles. The Lake County portion of the watershed is 50.3 square miles, and is the smallest of the county's four major watersheds.

Three tributary streams make up the North Branch in Lake County: the Skokie River, Middle Fork North Branch (also known as West Skokie), and the West Fork North Branch. The northern reaches of the three tributaries are intermittent and interspersed with wetlands. The Middle Fork and Skokie are perennial streams south of Rockland Road. The West Fork maintains perennial flow south of Old Mill Road.

NORTH BRANCH OF THE CHICAGO RIVER WATERSHED

Drainage Area Square Miles: 50.3
Percent Area of Lake County: 11%

Subwatersheds:

Skokie River
Middle Fork
West Fork

Publicly Owned Land: 1,655 Acres
Wetlands: 4,390 acres

Flood Damage Profile

The Flood Problem Areas Inventory identified 35 flood problem sites in the North Branch of the Chicago River watershed. The primary cause of the largest number of flood problems in the watershed can be attributed to overbank flooding of areas adjacent to the channels.

Poor local drainage is also a significant cause of flooding affecting 54% of the sites in the North Branch. Twenty-two of the problem sites are located in mapped floodplains, with fourteen of

North Branch of the Chicago River Watershed

Municipalities:

Bannockburn	Highwood	North Chicago
Deerfield	Lake Bluff	Park City
Green Oaks	Lake Forest	Riverwoods
Gurnee	Lincolnshire	Waukegan
Highland Park	Mettawa	

Townships:

Deerfield	Vernon	Waukegan
Libertyville	Warren	West Deerfield
Shields		

County Districts:

7th, 9th, 11th, 13th, 14th, 15th, 16th, 21st, 22nd

Drainage Districts:

East Skokie	Union #1 Middle Fork
West Skokie	Union #1 West Form

those sites also in the floodway. Thirteen of the flood problem sites are located in areas not mapped as floodplains. Ten of the eleven sites where local drainage problems are the primary cause of flooding are not mapped as floodplains on Flood Insurance Rate Maps.

Table 3-7 summarizes the number of sites affected by various types of flood problems for each of the watershed's nine subwatersheds. Table 3-7 also provides a picture of the number of site located in mapped floodplain areas by subwatershed.

Table 3-8 presents a summary of flood damage information (buildings, critical facilities and roads subject to flooding) for each subwatershed collected in the Flood Problem Areas Inventory.

From the information worksheets gathered during the Flood Problem Areas Inventory, "Flood Problem Hotspots" were identified within each subwatershed. "Hotspots" were identified based on the number of structures affected, and the frequency and severity of flood damage. The hotspots are numbered by their subwatershed number, followed by a site number that was assigned as they were identified.

Flood Problem Hot Spots

Subwatershed No. 24 - Skokie River - Some of the information for the watershed description comes from "North Branch Chicago River Skokie River Study Narrative", Illinois Department of Transportation, Division of Water Resources, 1994.

Nineteen flood problem sites were identified in the Flood Problem Areas Inventory. Hotspots include:

- ✓ Site 24-01 roughly includes the area north of Washington St. between LeBaron and Noll Avenue in Waukegan. Flooding caused by poor

local drainage impacts ten to twelve businesses five to six times per year and closes off Washington Street about every five years.

North Branch Watershed Flood Problem Sites (35 total)*

Flood problem type/hazard	Primary cause	Sites affected**
overbank flooding	17	19
local drainage problems	11	19
depressional flooding	6	9
septic problems		2
sewer back-up	1	4
erosion		

*A flood problem site may include multiple buildings, roads or other infrastructure.

** More than one type of flooding may occur at a problem site.

- ✓ Site 24-03 includes the area north and south of 22nd Street between Northern Avenue and Route 41 in North Chicago. Flooding caused by poor drainage in a depressional location causes road closure and impacts Abbott warehouse and Commonwealth Edison substation.

Table 3-7. North Branch of the Chicago River Watershed Flood Problem Sites

Sub-watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Type of Flood Problem						Site Location		
				Overbank Flooding	Local Drainage Problems	Depressional Flooding	Septic Problems	Sewer Back-up	Erosion	Flood-plain	Floodway	Outside Flood-plain
24	Skokie River	21.9	19									
	Primary Cause of Flood Problem:			8	8	2		1		12	9	7
	Number of Sites Affected By:**			10	11	3		3				
25	Middle Fork	19.8	13									
	Primary Cause of Flood Problem:			7	2	4				7	5	6
	Number of Sites Affected By:**			7	7	6	1	1				
26	West Fork	8.6	3							3		
	Primary Cause of Flood Problem:			2	1							
	Number of Sites Affected By:**			2	1			1				
	Totals:	50.3	35							22	14	13

*A flood problem site may include multiple buildings, roads or other infrastructure.

** More than one type of flooding may occur at a problem site.

Table 3-8. North Branch of the Chicago River Flood Damage Data

Sub-Watershed Number	Watershed Name	Drainage Area (square miles)	Total Flood Problem Sites Identified	Estimate of Buildings Subject to Flooding	Critical Facilities Subject to Flooding or Closure	Roads or Bridges Closed or Threatened by Flooding	Repetitive Loss Properties
24	Skokie River	21.9	19	120-216	7	17	6
25	Middle Fork	19.8	13	50-95		10	4
26	West Fork	8.6	3	14-30		4	28
	Totals:	50.3	35	184-341	7	31	38

- ✓ Flooding caused by poor drainage results in Route 41 closure two to three times per year.

Site 24-14 in Knollwood Subdivision, Shields Township has three apartment buildings that flood due to poor drainage following any significant rain.

- ✓ Site 24-15 south of Route 137 at Great Lakes Naval Training Center in North Chicago experiences overbank flooding from the Skokie in Forrestal Village and the Naval Training Center Supply.
- ✓ Site 24-16 is the Willow Glen Golf Course at the Great Lakes Training Center. Overbank flooding affects a former superfund site with monitoring wells during very heavy rains.

Subwatershed No. 25 - Middle Fork, North Branch Chicago River -
Thirteen flood problem sites were identified in the inventory, including one hotspot:

- ✓ Site 25-1, Del Mar Woods, is a subdivision of 80 homes that was built in a depressional location. A series of drainage improvement projects has reduced much of the flooding, yet flood problems continue related to street closures and yard flooding.

Subwatershed No. 26 - West Fork, North Branch Chicago River -
Three flood problem sites were identified in the inventory.

- ✓ There are 13 repetitive loss properties located in Deerfield in the West Fork subwatershed. Most of the properties are between Route 43 and I-94, and North Avenue and Lake-Cook Road. Four of the repetitive loss properties occur at one location.
- ✓ Site 26-1 south of Keller Park in Deerfield includes eight to ten homes that are subject to overbank flooding and sewer backup. One repetitive loss property is located at this site. Road access is restricted at Forestway Drive and Laurel Avenue.
- ✗ The installation of the Deerfield and Bannockburn Reservoirs has greatly reduced flood damage in this West Fork Subwatershed. However, heavy rainfall run-off events in May of 1996 and February 1997 resulted in flooding in Riverwoods and Deerfield upstream of Structure 29A (Deerfield Reservoir) at Lake-Cook Road and Structure 27 (Duffy Lane Reservoir). These flood sites were not identified in the Flood Problem Areas inventory that conducted in 1995 for this report, therefore, they are not included in the following summary. Further study by the Corps in 1996-1997 resulted in recommendations to modify both reservoirs to reduce backwater flooding impacts.

Chapter 4. Repetitive Losses

Repetitive loss properties	4-1
Flood audits.....	4-4
Property protection measures.....	4-5
Repetitive loss areas.....	4-9
Repetitive loss area prioritization	4-12
Acquisition.....	4-16
Recommendations.....	4-17

Repetitive loss properties

One of the best ways to protect a property owner from the consequences of flooding is to insure the floodprone property. The National Flood Insurance Program (NFIP) makes flood insurance available for all properties in Lake County (except within the Village of Highwood). By the end of 2000, nearly 4,000 properties in Lake County had flood insurance with over \$500,000,000 in total coverage.

The NFIP is administered by the Federal Emergency Management Agency (FEMA). FEMA classifies certain properties as "repetitive loss properties." These are properties that have two or more NFIP claim payments of over \$1,000 during any ten-year period since 1978. Although repetitive loss properties represent only 2% of all flood insurance policies nationally, these properties account for over 30% of all the dollars paid in flood claims. In Lake County, repetitive losses represent 2.7% of flood insurance policies and account for about 25% of all claims that have been paid.

Because a relatively small number of repetitively flooded properties can have a disproportionate impact on the NFIP, there are several programs that encourage communities to address their repetitive loss properties:

- FEMA's Flood Mitigation Assistance Program provides funds for acquiring or elevating repetitive loss properties.
- The State's mitigation funding programs have placed repetitive losses as a priority concern for funding.
- FEMA's Community Rating System provides flood insurance premium reductions to participating communities. In order to join, a community must map its repetitive loss areas, provide information on flood protection to each property annually, and, if there are more than 10 such properties, prepare a repetitive loss plan. This document is Lake County's repetitive loss plan and meets the CRS criteria.

Repetitive loss terminology

Repetitive loss: a property that had two or more NFIP claim payments of over \$1,000 during any ten-year period since 1978.

NFIP: National Flood Insurance Program

FEMA: Federal Emergency Management Agency

FIRM: Flood Insurance Rate Map – a map prepared by FEMA showing the 100-year or base floodplain.

Pre-FIRM: a building built before the date of the community's FIRM.

Post-FIRM: a building built after the FIRM date. Post-FIRM buildings were required to be protected from the flood level shown on the FIRM.

A Zone: the 100-year floodplain shown on the FIRM

B Zone: the 500-year floodplain shown on the FIRM

X Zone: areas on the FIRM that are outside the 500-year floodplain. X Zone properties may still be subject to flooding from local drainage or other unmapped sources.

Base flood: the 100-year flood (see page 2-9)

Base flood depth: the depth of the base flood over the lowest floor of a building.

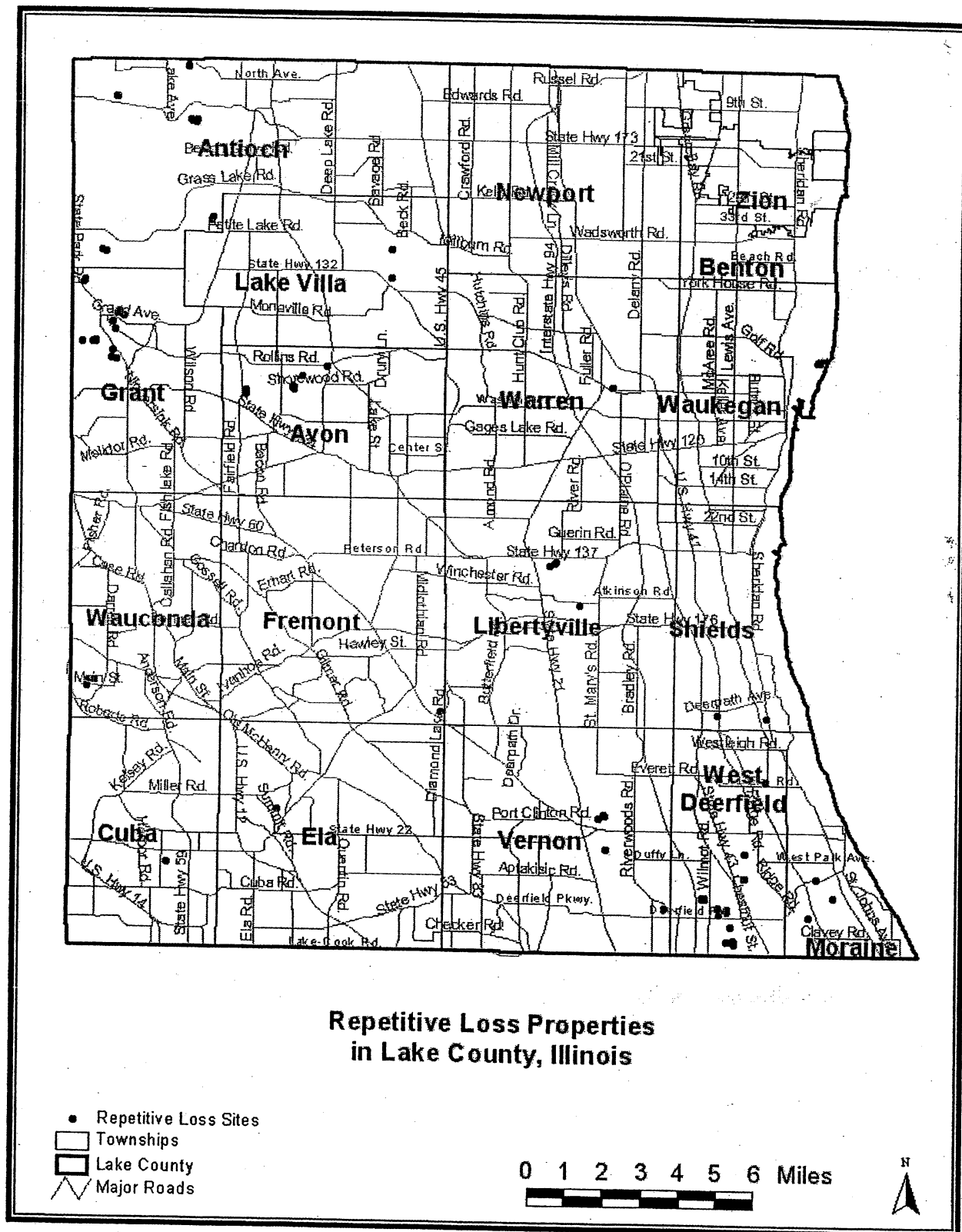
Low opening: the lowest point of surface water entry into a building with a basement. This could be a window well or the doorway of a walk-out basement.

Flood audit: a report on measures that would protect a building from flood damage.

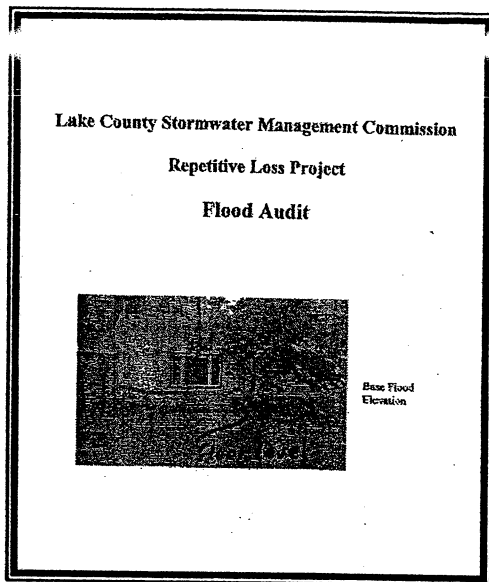
Lake County's repetitive losses

There are 58 properties on FEMA's repetitive loss list for Lake County. They are in 44 different locations. In the Summer of 2000, SMC staff visited these 44 sites. During these visits, they identified neighboring properties that were similarly situated and probably subject to the same repetitive flooding. There are various reasons why they were not on the FEMA list, most likely because they were not insured during all the floods and therefore did not file flood insurance claims with the NFIP.

These neighboring properties were added to the County's list and included in "clusters." SMC also reviewed reports of repetitive flooding from residents and local officials. These reports added 7 more locations. Altogether, the SMC identified 108 repetitive loss properties in 52 locations. Twenty-three of the locations have one property while 29 are in clusters of 2 to 11 properties. These locations are plotted on the map on the next page.



Flood audits



In the Fall of 2000, SMC contracted with French & Associates, Ltd. to conduct "flood audits" of each of the 108 properties. Each property was visited and basic information about the building and the flood hazard it is exposed to was collected.

Of the 108 properties, three were dropped from consideration. One property had been acquired and cleared, one had been rebuilt above the base flood elevation, and one was gated and inaccessible (the owner did not respond to an invitation to have an audit conducted). Therefore, 105 audits were completed.

The 105 repetitive loss properties represent a cross section of Lake County properties. Here are some summary statistics on them:

- 33 are in unincorporated areas
- 31 are in Deerfield
- 14 are in Fox Lake
- 12 are in Round Lake Beach
- 15 are in 9 other municipalities

- 64 are in the mapped 100-year floodplain
- 12 are in the mapped 500-year floodplain
- 29 are outside mapped floodplains

- 35 are on crawlspaces
- 21 have slab on grade foundations
- 30 have basements
- 19 are trilevels

103 are single family homes and 2 are commercial structures.

All but 9 were deemed "well maintained."

Property values range from \$31,000 to \$685,000.

The average market value is \$210,000

The buildings were constructed between 1930 and 1995. All but three were built before 1980. Two of the three are not in the floodplain while the third is one foot above the 100-year flood level. None of these three are on the FEMA list. They were added because of complaints of chronic flooding in the areas.

Mitigation recommendations

A decision tree was followed to determine appropriate property protection measures for each building. A benefit/cost analysis was conducted to see if acquisition or the recommended property protection measure were cost-effective.

The flood audits are considered preliminary reports based on data collected from public sources and a visit to the property site. The data collection effort did not include a close inspection of the building or its interior. The surveyors did not go inside and, in most cases, did not speak to the occupant.

On April 17, 2001, SMC invited all 105 property owners to a public meeting to review the audits and their findings. The audit reports were given to those who attended. The remainder were mailed to the owners. To date, there have been no requests for changes or corrections to the reports. Therefore, this chapter is based on the data collected on the 105 repetitive loss properties during the audits.

Two general approaches were considered to mitigate repetitive loss properties: individual property protection measures and area mitigation projects. These approaches are discussed in the next two sections.

Property protection measures

Chapter 5 reviews the full range of mitigation strategies and measures that can be taken on a county-wide or community basis. Individual property protection measures are described on pages 5-14 – 5-22 in Chapter 5. They include:

- Building relocation
- Building elevation
- Barriers
- Dry floodproofing
- Basement protection berm
- Wet floodproofing
- Insurance

Recommended measures

Each of the 105 flood audits contained a “first retrofitting recommendation” and a “second retrofitting recommendation” for the audited property. A mitigation decision matrix was used to recommend which of the property protection measures were most appropriate for each property. The matrix is on the next page.

This matrix was used to make the initial first and second recommendations for each building. These recommendations were reviewed by French & Associates staff and refined based on their professional judgment. For example, instead of just recommending "barrier" or "elevation," a recommendation may say "barrier across driveway" or "elevate and fill in the basement."

The reports were developed as recommendations to the property owners. Acquisition was not a listed alternative because owners would not buy their own property. However, a recommendation for "relocation" can be considered a recommendation for an agency to acquire the property.

Property Protection Decision Matrix			
Foundation	Base flood depth	First Recommendation	Second Recommendation
Slab			
First floor	< 0	Above BFE *	Above BFE *
First floor	< 2 feet	Barrier	Dry floodproof
First floor	≥ 2 feet	Elevate/relocate	Elevate/relocate
Crawlspace			
Low opening	< 0	Above BFE *	Above BFE *
First floor	< 0	Wet floodproof	Barrier
First floor	≥ 0	Elevate	Elevate
Basement			
Low opening	< 0	Above BFE *	Above BFE *
Low opening	< 2 feet	Barrier	Basement berm
First floor	< 0 feet	Wet floodproof	Elevate/relocate
First floor	≥ 0 feet	Elevate/relocate	Wet floodproof
Trilevel			
Low opening	< 0	Above BFE *	Above BFE *
Low opening	< 2 feet	Barrier	Barrier
Low opening	≥ 2 feet	Relocate	Wet floodproof
* BFE = base flood (100-year) elevation. See also the terminology box on page 4-2.			

The "first retrofitting recommendation" was always a measure that would protect the building to the base flood elevation (BFE). In some cases, the second recommendation did not protect to the BFE, but it was more affordable. For example, the first recommendation for a building with a basement may be relocation at a cost of \$200,000 while the second may be a basement protection berm that might only provide protection from the 10-year flood, but was much less expensive (\$12,500).

Recommended measures

Using the property protection decision matrix and professional judgment, French & Associates recommended retrofitting measures for the 105 properties. A summary of the recommendations is in the box below.

Mitigation Recommendations		
Mitigation measure	First recommendation	Second recommendation
Barrier	26	17
Barrier across driveway	0	9
Barrier/combination of measures	0	20
Basement berm	2	16
Dry floodproof	0	13
Elevate	23	0
Elevate/fill in basement	17	0
Elevate/relocate	17	1
Relocate	5	0
Wet floodproof	5	10
Wet floodproof crawlspace	10	19
	105	105

Costs

Costs were estimated for each measure. The following figures were used:

Building relocation: the estimated market value of the property

Building elevation: \$30,000

Barriers and basement protection berm: \$12,500

Dry and wet floodproofing: \$6,000

The market value of the property (building and land) was used as the relocation cost estimate because it was concluded that these buildings may be appropriate for acquisition. These were trilevels or buildings on slab that would be very expensive to physically move to a flood-free site.

Buildings with basements were generally recommended for elevation (and fill in the basement) to protect them from the base flood.

The costs for the retrofitting measures were calculated using formulas in *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings* (FEMA 259). Typical Lake County conditions were used. The property owners were advised to obtain more accurate, site-specific cost estimates before making a decision to proceed.

Acquisition

While acquisition is the preferred mitigation measure for a floodprone property, the table on the previous page shows that there are many feasible alternatives *when only the individual buildings are considered*. The property protection decision matrix does not reflect other reasons to consider acquiring a property and clearing the lot, such as eliminating a health problem due to flooded septic systems, providing additional flood storage or conveyance areas, and expanding adjacent parks.

Using the estimated market value, it would cost over \$22 million to acquire all 105 identified repetitive loss properties. While some properties are appropriate for acquisition, many are not. Those most appropriate should be acquired first. SMC used the audit data to submit an application to the Illinois Department of Natural Resources in April 2001 for funding to acquire 7 of the 105 properties.

It should also be noted that most cost-share funding programs and the County's policy is to only fund voluntary acquisition projects. There are no plans to condemn properties or force their sale for flood protection.

Insurance

Each audit report had a section on flood insurance, which was recommended in all cases. Each had a table, such as the one below, that presents the expected annual premium for a policy. The rates are the same for similar types of buildings in similar FIRM zones (i.e., the rates are the same for all buildings with a basement or floor below grade in the 100-year floodplain or A Zone).

Flood Insurance Premiums: Basement or Trilevel, A Zone			
Amount of coverage	Cost for coverage	Constants and fee	Annual premium
\$100,000 structural coverage	\$545	\$155	\$930
\$40,000 contents coverage	\$230		
\$50,000 structural coverage	\$365	\$155	\$678
\$20,000 contents coverage	\$158		

Recommendations

Each audit report contained the following recommendations to the property owners:

1. Review the Flood Audit.
2. Consider the recommended retrofitting approach and compare it with the costs and problems associated with remaining unprotected from flood damage.
3. Obtain or maintain flood insurance coverage in the amount of expected damage to the building's structure and contents.
4. Get a more detailed cost estimate for implementing the retrofit that is recommended in this report.
5. Talk to SMC staff regarding the flood hazard, retrofitting and possible sources of financial assistance for cost-sharing a retrofit project.

Repetitive loss areas

The second approach to mitigating the County's repetitive loss problem is to develop projects for the repetitive loss areas or neighborhoods affected by chronic flooding.

Summary data

As described on page 4-2, there are 52 repetitive loss areas in Lake County, which are identified on the map on page 4-3. Basic information on these areas is summarized in the table on the next page. This table and the map on page 4-3 show that the areas are scattered across the County.

There are two concentrations of repetitive loss areas: in the Fox Lake area in the northwest corner of the County and in West Deerfield Township in the southeast. As seen in the Summary Table, these are in the Upper Fox and West Fork of the North Branch of the Chicago River subwatersheds.

Twenty-six repetitive loss areas are in the Special Flood Hazard Area or 100-year floodplain shown on the Flood Insurance Rate Map (FIRM) for the County. This is also known as the AE Zone. Three are in the mapped 500-year floodplain or B Zone. The source of flooding for all but one of these areas was determined to be the nearby river or lake that was mapped as floodplain.

Repetitive Loss Areas – Summary Table

Area #	Sub-Watershed Name	City	FIRM Zone	Flood Source	Number of Properties	Number Audited
RL-01	Upper Fox	Unincorporated	AE	Nippersink Lake	4	4
RL-02	Upper Fox	Unincorporated	AE	Petite Lake	5	5
RL-03	Upper Fox	Unincorporated	AE	Lake Marie	4	4
RL-04	Upper Fox	Unincorporated	AE	Channel Lake	3	2
RL-05	Upper Fox	Unincorporated	AE	Channel/Marie Lakes	1	1
RL-06	Upper Fox	Unincorporated	AE/X	Fox River/Chain O'Lakes	3	3
RL-07	Upper Fox	Unincorporated	AE/X	Nippersink Lake	4	3
RL-08	Upper Fox	Unincorporated	X	Unknown	1	1
RL-09	Upper Fox	Fox Lake	AE	Fox Lake	6	1
RL-10	Upper Fox	Fox Lake	AE	Fox Lake	5	3
RL-11	Upper Fox	Fox Lake	AE	Pistakee Lake	4	1
RL-12	Upper Fox	Fox Lake	X	LD	1	1
RL-13	Squaw Creek	Round Lake Beach	AE/X	Trib to Round Lake Drain	5	5
RL-14	Squaw Creek	Round Lake Beach	X	Local drainage	1	1
RL-15	Squaw Creek	Round Lake Beach	AE	Local detention pond	1	1
RL-16	Squaw Creek	Round Lake Beach	AE	Trib to Round Lake Drain	5	5
RL-17	Lower Fox	Fox Lake	AE	Pistakee Lake, Depression	5	4
RL-18	Lower Fox	Fox Lake	AE	Pistakee Lake	2	1
RL-19	Lower Fox	Fox Lake	AE	Pistakee Lake	3	1
RL-20	Lower Fox	Fox Lake	AE	Pistakee Lake	5	1
RL-21	Mutton Creek	Island Lake	X	LD	1	1
RL-22	Flint Creek	Barrington	X	LD	1	1
RL-23	Flint Creek	Barrington	X	Depressional flooding	1	1
RL-24	Flint Creek	Lake Zurich	X	Echo Lake	1	1
RL-25	North Mill Creek	Lindenhurst	X	LD	3	1
RL-26	Mill Creek	Lindenhurst	X	LD, sewer backup	6	2
RL-27	Upper Des Plaines	Unincorporated	AE	Des Plaines River	4	3
RL-28	Upper Des Plaines	Unincorporated	AE	Des Plaines River	1	1
RL-29	Upper Des Plaines	Gurnee	AE	Des Plaines River	3	1
RL-30	Indian Creek	Unincorporated	X	Diamond Lake	4	1
RL-31	Lower Des Plaines	Unincorporated	AE	Des Plaines River	3	3
RL-32	Lower Des Plaines	Unincorporated	X	Des Plaines River	2	1
RL-33	Lower Des Plaines	Riverwoods	X	Unknown	1	1
RL-34	Buffalo Creek	Unincorporated	X	Local detention pond	1	1
RL-35	Bluff/Ravines	Lake Forest	X	Depressional flooding	1	1
RL-36	Skokie River	Deerfield	AE	Skokie River	3	1
RL-37	Skokie River	Highland Park	X	Unknown	1	1
RL-38	Skokie River	Highland Park	B/AE	LD	1	1
RL-39	Skokie River	Lake Forest	X	LD	1	1
RL-40	Skokie River	Lake Forest	B	Skokie River	1	1
RL-41	Skokie River	Unincorporated	X	LD	1	1
RL-42	Middle Fork CR	Green Oaks	X	Trib to Middle Fork NBCR	1	1
RL-43	Middle Fork CR	Deerfield	X	LD	1	1
RL-44	Middle Fork CR	Deerfield	X	Unknown	1	1
RL-45	Middle Fork CR	Highland Park	X	LD	1	1
RL-46	West Fork CR	Deerfield	AE/X	West Fork NBCR	10	9
RL-47	West Fork CR	Deerfield	AE/X	West Fork NBCR	5	5
RL-48	West Fork CR	Deerfield	X	LD	4	1
RL-49	West Fork CR	Deerfield	AE	West Fork NBCR	11	4
RL-50	West Fork CR	Deerfield	B	West Fork NBCR	2	2
RL-51	West Fork CR	Deerfield	B	West Fork NBCR	6	6
RL-52	West Fork CR	Deerfield	X	LD	2	1

LD = local drainage NBCR = North Branch of the Chicago River

153 106

X Zone areas

Twenty-three of the 52 repetitive loss areas are completely in the X Zone, i.e., on land outside the mapped 500-year floodplain. Field survey and elevation checks found the following about the sources of flooding for these X Zone areas:

- 12 are subject to flooding from local drainage
- 2 are subject to depressional flooding
- 1 is flooded from overflow from an adjacent detention pond
- 4 are subject to flooding from a nearby river or lake. Based on the surveyed elevations, they should be located in a mapped AE Zone
- 4 are flooded from unknown sources

Local drainage and depressional flooding problems are described on pages 2-11 – 2-13. They result from locating buildings in a drainageway or in a depressional ponding area. Inadequately maintained drainage ditches, undersized storm sewers, and failing tile drains or storm sewers contribute to these flood problems, too.

Four properties are flooded from unknown sources. Field investigations did not determine why the sties would be subject to flooding. They appear to be on higher ground or otherwise flood free. In three cases, the owners did not return a questionnaire. In the fourth case, the owner had not experienced any flooding and did not know the source of flooding.

It is possible that there are errors in FEMA's repetitive loss addresses. This has been known to occur in other communities. For example, sometimes the listed address is not the floodprone property, but the billing address of the property owner. Additional field work and/or property owner participation is needed.

Number of properties

The last two columns in the summary table on page 4-10 are "number of properties" and "number audited." As explained on page 4-4, 108 repetitive loss properties were visited and audits were completed for 105. The one that could not be surveyed has been kept on the list.

In some areas, it may make more sense to approach flood damage mitigation on an area or neighborhood level rather than address the properties individually. This is especially true of those clusters with more than one property that are subject to local drainage problems. In these situations, a flood control project may be more cost effective than doing a retrofitting project on each building. Similarly, it may make more sense to acquire all affected properties and reuse the land as a park than to relocate some buildings and leave others for retrofitting projects.

An area project has the added benefit of public involvement. A County-funded drainage improvement project will be properly designed, constructed and maintained while a floodproofing project is subject to the owner's care (and that of a future owner who may not appreciate the flood protection it provides).

A second review of the repetitive loss areas was conducted. The result was a count of all properties likely to be subject to the same flood hazard as the ones that were audited. These numbers are in the "number of properties" column.

Twenty-three of the 52 areas have only one property subject to historical repetitive flooding. Seventeen of these are outside the mapped floodplain. Eleven are subject to local drainage and four are the four properties subject to "unknown" flooding.

Repetitive loss area prioritization

The recommendations in the flood audits provide appropriate flood protection steps for the owners of the repetitive loss properties. However, before the County or another government agency funds a mitigation project to reduce repetitive losses, the potential for an area-wide or neighborhood project should be investigated. Where there are numerous properties in an area, a "site specific" mitigation plan would be helpful.

Severity scoring

To determine where to start this additional attention, the 52 areas were prioritized according to the severity of the problem they faced. A "severity scoring system" was developed using information collected from the audits. Four factors were used. They are shown in the table on the next page and described below.

Years of flood: Only the FEMA records were used. Property owners reported more flooding on the questionnaires that were returned at the beginning of the field surveys. However, many times those were reports of flooding in yards or streets that did not damage buildings.

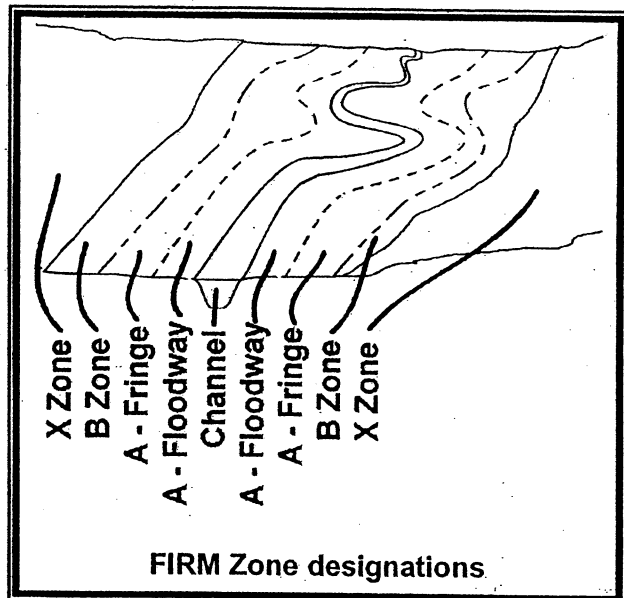
For this priority setting, only floods severe enough to result in insurance claim payments of more than \$1,000 were counted. Under the severity scoring system, an area received one point for each year (more than 2) that a flood resulted in an NFIP claim payment.

Severity Scoring Factors

Area #	Years of Flood	Properties in Floodway	Private water or sewer	Acquisition B/C > 1	Alternate measure B/C > 1	Severity Score
RI-01	79.83.93		Yes	2	2	3
RI-02	79.86.93		Yes			2
RI-03	79.82.86.93		Yes	1		4
RI-04	79.86.93		Yes			2
RI-05					1	1
RI-06	86.93		Yes			1
RI-07			Yes			1
RI-08	80.86					0
RI-09	79.86.93					1
RI-10	79.82.83.86.93		Yes		3	5
RI-11	79.83					0
RI-12	86.93					0
RI-13	86.93		Yes			1
RI-14	86.93		Yes	3	4	2
RI-15			Yes			1
RI-16			Yes			1
RI-17	79.83.86.93		Yes		2	4
RI-18	79.86			1	1	1
RI-19	79.86				1	1
RI-20	79.86					0
RI-21						0
RI-22			Yes			1
RI-23	83.86.90					1
RI-24						0
RI-25	79.86					0
RI-26	93.97.98		Yes			2
RI-27	82.83.86	3	Yes	2	3	4
RI-28		1	Yes			2
RI-29	79.86.89.93	1		1	1	4
RI-30						0
RI-31	79.83.86.87.96	1	Yes	2	2	6
RI-32	79.86	1		1	1	2
RI-33	82.87					0
RI-34						0
RI-35	82					0
RI-36	94.96	1		1	1	2
RI-37	82					0
RI-38	81.82					0
RI-39	82.86					0
RI-40	82			1	1	1
RI-41	81.86					0
RI-42						0
RI-43	82.86					0
RI-44	82					0
RI-45	82.87					0
RI-46	82	1			9	2
RI-47	82.85			1	5	1
RI-48	82.87					0
RI-49	82	2		1	4	2
RI-50	82				1	1
RI-51	82.87			2	6	1
RI-52	81.82					0
		11		19	48	

This approach is based on the premise that every property has been flooded twice, so the scoring differentiates between those that have only been flooded twice and those that have had more than two floods.

Properties in the floodway: The floodway is explained on page 2-10. The FIRM zone designations and their relative proximity to a stream channel are shown in the figure in the box.



The floodway has higher flood velocities and it represents an area important for the conveyance of floodwaters. Those areas with one or more properties in the floodway received one point. This factor also differentiates between the deeper floodway flooding and the shallower, less hazardous, flooding in the fringe and X Zones.

Health concerns: If an area does not have public water or sewer service, it received one point. This information came from the questionnaires returned by the property owners at the beginning of the survey work.

Mitigation benefit/cost: Many government programs, including FEMA's mitigation

funding programs, require that the benefits of a funded project exceed the costs of the project. To determine if this will happen, a benefit/costs analysis is conducted. The flood damage reduction benefits expected over the life of a project are expressed in dollars. This figure is divided by the cost of the project. If the resulting ratio (B/C) is greater than one, the benefits have been shown to exceed the cost.

The numbers in the columns headed "B/C > 1" are the numbers of properties where some mitigation measures appear to be cost-effective. If the average benefit/cost ratio of either acquisition or the first recommended mitigation measure for the audited properties in the area was greater than one, then one point is provided in the scoring system.

Using this number does not mean that the measures with the higher B/C ratios would be implemented. B/C ratios greater than one mean that the damage potential is high compared to the cost of the property or the cost of the retrofitting measure.

For example, in 24 areas, the B/C for acquisition was less than 0.25. This shows that while flooding in these areas is repetitive and a nuisance, it is not very severe when compared to the cost of acquiring and clearing the property.

As with properties in the floodway, this factor favors repetitive loss properties in mapped floodplains. There were no benefit/cost ratios in the X Zones because there are no data on flood frequency or elevations for areas outside mapped floodplains.

Findings

The severity scores can be used to break the 52 repetitive loss areas into three categories: high, medium and low priorities:

- 6 areas are high priority with scores of 4 – 6
- 25 areas are medium priority with scores of 1 – 3
- 21 areas are low priority with scores of zero

The low priority areas have been flooded twice, but have no properties in the floodway, are on public water and sewer so they don't have a major health threat, and have no buildings that were audited and found to have a cost effective mitigation measure. This does not mean that they have no flood problem – they have been shown to have a repetitive flood problem. What the score means is that compared to the other 30 areas, there is nothing to distinguish them for immediate attention.

The shortcoming of this system is that benefit/cost analyses have not been conducted on X Zone properties. FEMA's analysis software requires data on the 10- and 100-year flood elevations and these data are not available in X Zones.

This prioritization of repetitive loss areas is not meant as an exact statement of how severe flooding is. It is a general ranking based on the factors discussed above. The weights can be adjusted, depending on the objective, as is shown in the next section on acquisition.

High priority sites

Six repetitive loss areas have severity scores of "4" or greater:

- RL-03 has been flooded four times since 1979, has properties on private water or sewer, and has at least one building where the benefit/cost ratio for acquisition is greater than 1.0. In fact it is 2.51.
- RL-10 has been flooded five times, has properties on private water or sewer, and has three buildings that were audited and found to have cost-effective retrofitting options. The audits found that two buildings had B/C ratios for acquisition of less than 0.5, but they were 1.87 for elevation. A third building had B/Cs of 0.72 and 4.86, respectively.

- RL-17 was flooded four times, has properties on private water or sewer, and has two buildings with favorable benefit/cost ratios for retrofitting by elevation.
- RL-27 has seen three floods since 1978, has three properties in the floodway, has properties on private water or sewer, has two buildings with a B/C > 1.0 for acquisition and elevation and one more with a B/C > 1.0 for elevation.
- RL-29 was flooded four times. It is one building in the floodway with very high benefit/cost ratios for acquisition and elevation.
- RL-31 has the highest score: five floods, one property in the floodway, private water or sewer, and two buildings with B/C ratios greater than 1.0 for acquisition. The B/C ratios for elevating those two buildings are even higher.

Acquisition

From time to time cost-share funding becomes available to purchase and clear floodprone properties. Recently, State and FEMA funds have been offered as a match for local funds for acquiring repetitively flooded properties. An objective ranking system for the County's repetitive loss properties and areas is therefore useful.

Acquisition scoring

The severity scoring system can be used to rank properties and areas based on their suitability for acquisition. The following factors were deemed most important:

Severity score: This is an objective way to determine which areas have the worst repetitive flood problem.

Benefit/cost ratio: Many funding programs require that the B/C be greater than 1.0. The software is not exact, so the approach displayed in the following table screens out properties with a B/C of less than 0.75. It is possible that, with further information, a B/C between 0.75 and 1.0 could increase. In fact, there were only two buildings that fall into this category and they both have B/C ratios greater than 0.9.

This factor also screens out X Zone properties. That is not a problem where State and Federal funding is involved, because current State and Federal programs will not finance acquisition of a property outside the mapped floodplain. However, if the problem is severe enough, the County may consider acquisition with County funds.

Cost: A fixed amount of funding dollars can acquire more lower cost properties than expensive properties. Using this factor also favors lower income families.

Scores were given for the market values of the properties. Market values are based on tax assessments times a multiplier of 3.2. The lower the market value, the higher the score.

Market Value	Score
< \$100,000	4
\$100,000 - \$150,000	3
\$150,000 - \$200,000	2
\$200,000 - \$300,000	1
> \$300,000	0

Findings: The results of this acquisition scoring system are seen in the table on the next page. Only those 21 buildings with a B/C ratio greater than 0.75 for acquisition are listed.

The far right column is the acquisition score. It is based on the formula :

$$(\text{severity score} + \text{cost score}) \times \text{B/C ratio} = \text{acquisition score.}$$

One property stands out as top priority for acquisition. It is in repetitive loss area 28 and has an acquisition score 61.84. It would cost \$90,749 to acquire, based on its estimated market value. This cost does not include the additional expenses for appraisal, legal fees, clearance, etc.

Five properties fall into a grouping with scores between 18 and 25.52. They are in repetitive loss areas 14, 26, 30 and 50. Acquiring them would cost approximately \$750,000 (plus the other property transfer expenses).

Again, these scores do not mean that other properties should not be acquired. Based on the input factors, they identify which ones should go first.

Recommendations

The following actions should be pursued to best use available resources to reduce repetitive flood losses:

1. SMC should begin more detailed investigations of the 52 repetitive loss areas, in priority order based on the severity scoring system. An initial on-site investigation should be conducted to determine if a site-specific plan should be conducted on a neighborhood basis with resident involvement.
2. SMC should seize every funding opportunity to acquire or otherwise protect the high priority repetitive loss properties. However, acquisition should not be done in a vacuum. The condition of the neighboring properties and the whole repetitive loss area should be considered, too.

While it would be beneficial to conduct an area or site-specific plan before an acquisition decision is made, opportunities to acquire high priority properties should not be missed.

3. SMC should conduct a public information outreach program which would include an annual mailing to all properties in the repetitive loss areas. The mailing should be designed to fulfill the requirements of the Community Rating System and advise the property owners where they can get more help to protect themselves from flood damage.
4. SMC should train in-house staff in retrofitting, insurance and other property protection subjects so they can provide one-on-one technical advice and assistance to interested repetitive loss property owners.

Acquisition Priority Scores					
RL Area	Severity Score	Acq. B/C	Market Value	Cost Score	Acq. Score
RL-01	3	1.61	\$62,323	4	11.27
RL-01	3	2.15	\$176,150	2	10.75
RL-03	4	2.51	\$173,568	2	15.06
RL-14	2	1.11	\$69,034	4	6.66
RL-14	2	3.66	\$113,475	3	18.30
RL-14	2	4.44	\$122,278	3	22.20
RL-18	1	2.42	\$81,654	4	12.10
RL-27	4	1.33	\$98,858	4	10.64
RL-27	4	2.96	\$107,466	3	20.72
RL-29	4	7.73	\$90,749	4	61.84
RL-31	6	2.20	\$127,398	3	19.80
RL-31	6	1.59	\$326,480	0	9.54
RL-32	2	6.76	\$393,581	0	13.52
RL-36	2	2.44	\$368,762	0	4.88
RL-41	1	4.62	\$408,810	0	4.62
RL-47	1	0.90	\$198,077	2	2.70
RL-47	1	1.83	\$202,726	1	3.66
RL-49	2	4.44	\$257,155	1	13.32
RL-51	1	12.76	\$273,645	1	25.52
RL-51	1	0.92	\$286,595	1	1.84
RL-51	1	1.23	\$297,533	1	2.46

Chapter 5. Mitigation Strategies

Prevention	5-2
Property Protection	5-13
Natural Resource Protection	5-22
Emergency Services	5-27
Flood Control	5-35
Public Information	5-43

Six basic strategies may be applied to mitigate flood hazards. Each strategy includes mitigation measures that are appropriate for different conditions. For instance, planning and regulation measures as a prevention strategy are more appropriate for developing areas, while building relocation or elevation measures as a property protection strategy are remedies for existing flood problems.

Mitigation Strategies	
✓	Prevention
✓	Property Protection
✓	Natural Resource Protection
✓	Emergency Services
✓	Flood Control
✓	Public Information

Generally, using a combination of mitigation measures in a comprehensive flood mitigation program is the most cost-effective and environmentally friendly long-term solution to flood hazard reduction. But in many communities, different agencies or persons may be responsible for each strategy, making organization difficult.

As an example, in Lake County the Lake County Emergency Management Agency (LCEMA) coordinates emergency services, the Forest Preserve District purchases floodplain for natural resource protection, while the County and individual municipalities implement land use plans and regulations that can prevent flooding problems from getting worse.

A Flood Hazard Mitigation Plan can serve to coordinate the flood mitigation activities of all affected agencies into a unified comprehensive program that incorporates the best mix of mitigation measures from all six strategies.

The following sections provide more detailed discussions of the measures used in each of these six strategies. *Flood Hazard Mitigation in Northeastern Illinois: A Guide for Local Officials* and the National Flood Insurance Program's Community Rating System were the resources used for much of the information provided on mitigation measures. More detailed explanations of each strategy can be found in these references.

Prevention

Prevention Measures

- ✓ Planning
- ✓ Zoning
- ✓ Open space preservation
- ✓ Floodplain regulations
- ✓ Run-off reduction
- ✓ Drainage system maintenance
- ✓ Real estate disclosure

As the name implies, prevention measures are designed to keep flooding problems from getting worse. They insure that future development does not increase flood damage, and include actions that maintain the drainage system's capacity to carry away floodwaters. The cost of implementing most flood prevention measures is relatively low in comparison to most remedial measures to reduce flood damage.

Planning

"Planning" can cover a variety of community plans including, but not limited to, comprehensive plans, land use plans, transportation plans, capital improvement plans, and economic development plans. While plans generally have limited authority, they reflect what the community would like to see happen in the future. Plans also guide other local measures such as capital improvements and the development of ordinances.

Comprehensive and land use plans generally identify how a community should be developed and are the most likely tools for flood prevention. Use of the land can be tailored to match flooding hazards, typically by reserving flood prone areas for parks, recreational trails, open space, golf courses, or similar compatible uses.



One of the objectives of planning is to keep intensive development out of floodplains and sensitive areas.

Development in Lake County is directed by a variety of comprehensive and land use plans as well as through guidance from specialized plans. Generally, municipal governments produce comprehensive and/or land use plans that cover development within municipal boundaries, while the Lake County Department of Planning, Zoning and Environmental Quality (PZEQ) covers planning for the unincorporated areas of the county. PZEQ has also developed a long range plan, the **Lake County Framework Plan**, that covers the entire county through the year 2010.

Specialized plans such as the Comprehensive Stormwater Management and Natural Resources Plans address specific county-wide planning needs. Following the floods of 1986 and 1987,

Illinois enabling legislation was passed to allow counties in northeastern Illinois to develop stormwater management plans.

The **Lake County Comprehensive Stormwater Management Plan** (Stormwater Plan) was adopted in 1990 in response to worsening flooding, drainage and water quality problems. The Stormwater Plan provides guidance to the county and all municipalities and is the framework for creating and maintaining a countywide coordinated stormwater management system that will help prevent flood disasters and protect water quality.

The **Natural Resource Plan**, adopted in 1980, provides environmental planning guidance for lakes and ponds, floodplains, wetlands and drainageways. Implementation of the plan is through adopted zoning and subdivision regulations.

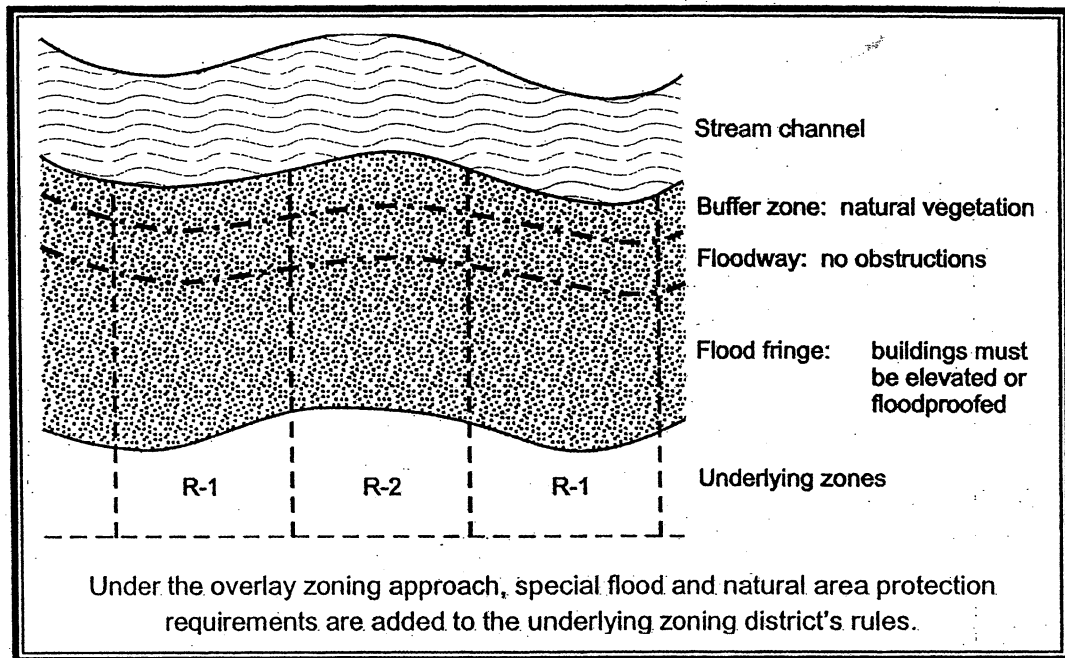
Considered Improvements

- Using "best available information" map the county's drainage system including streams, rivers, lakes, wetlands, floodplains and other depressional storage areas on watershed base. The map should be distributed and readily available to all units of government and private organizations for planning and development review purposes.
- The natural drainage system map should be combined with locations of steep slopes, mature forests, prime farmland, aquifer recharge areas and ecologically sensitive wildlife habitat areas on one watershed-based county-wide conservation and development map. The map should be distributed and readily available to all units of government and private organizations for planning and development review purposes.
- All Lake County municipalities and county departments should adopt the county-wide conservation and development map for planning and development review purposes.
- The county-wide conservation and development map should be incorporated into land acquisition planning by the Forest Preserve District, park districts and other land acquisition organizations.

Zoning

A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each district. Zoning can be used to control development so that existing flood problems are not worsened and new flood problems are not created.

Two zoning approaches are generally used to prevent inappropriate flood-prone development: separate districts and overlay zoning. Separate districts designate floodplain as a special zoning district that only allows development that is not susceptible to flood damage such as public use, conservation and agriculture. Overlay zoning adds special requirements for flood protection to the underlying zoning in areas subject to flooding.



NATURAL RESOURCE PROTECTION STANDARDS – LAKE COUNTY ZONING ORDINANCE

Natural Resource Protection Areas	Open Space Ratio
Floodplain	1.0
Wetland	1.0
Lake	1.0
Pond	1.0
Drainageways	0.5
Drainageway soils	0.5

The Lake County zoning ordinance, applicable to the unincorporated areas of Lake County, uses the overlay zoning approach. The Lake County ordinance classifies floodplains, wetlands, lakes, ponds, drainageways and drainageway soils with other natural resources as “natural resource protection areas.” This classification requires that a pre-determined ratio of open space be met for developments impacting the designated natural resources.

In addition, site development regulations limit the uses allowed in floodplains. Allowable uses, depending upon the underlying zoning district, may include parks, golf courses, boating facilities, parking lots, roads, nurseries and others.

Several Lake County municipalities have incorporated floodplain development restrictions into their zoning ordinances. A review of municipal zoning ordinances for development of the 1990 Comprehensive Stormwater Management Plan found that 19 of 29 zoning ordinances reviewed included floodplain districts/requirements. (Forty ordinances were col-

lected for the county's 51 municipalities, but only the 29 that were dated 1970 or later were reviewed.)

Since the adoption of the county's Watershed Development Ordinance (WDO) in 1992, municipalities and the County of Lake have incorporated the floodplain development restrictions of the WDO into their zoning and development ordinances.

Considered Improvements

- The county's Unified Development Ordinance (UDO) and municipal zoning ordinances should adequately address floodplain/drainage system protection by adopting a separate zoning classification for known "floodplains, wetlands and drainageways" rather than an overlay as is currently used.
- The UDO should incorporate a comprehensive definition of floodplain that includes first order streams and depressional areas as defined by the Watershed Development Ordinance (WDO).

Open space preservation

Keeping the floodplain open and free from development is the best approach to preventing flood damage. Preserving open space is beneficial to the public in several ways. Preserving floodplains and natural sites of water storage, such as wetlands and low-lying areas maintain the existing stormwater storage capacities of an area. These sites can also serve as recreational areas, greenway corridors and provide habitat for local flora and fauna. In addition to being preserved in its natural landscape, open space may also be maintained as a park, golf course, or in agricultural use.

Open space preservation should not be limited to only floodplain, as some upland areas within a watershed may be key to limiting runoff that will worsen flooding problems in adjacent or downstream lowlands. A significant increase in runoff from surrounding uplands will raise the base flood elevation and enlarge the floodplain boundary. Therefore, the amount of land maintained as open space will directly affect the level of flood hazard.



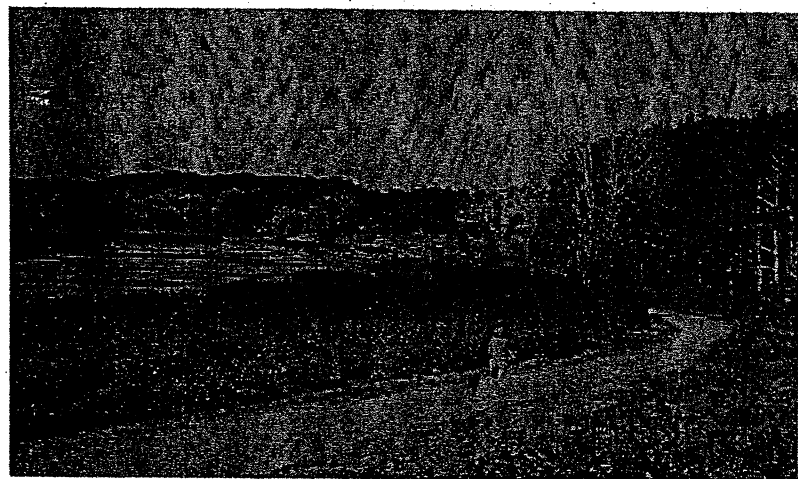
The Marriott Golf Course is an example of open space in the Des Plaines River floodplain.

Liberty Prairie Reserve

The Liberty Prairie Reserve is located in the area bordered by Routes 120 and 101 from north to south, and Route 21 and Prairie Crossing on Route 45 from east to west. The Reserve is a unique example of open space preservation that is a combination of public and private ownership. Approximately 1,500 acres of the 2,500 acre reserve is currently protected as open space. The natural landscape of the Reserve, combined with agricultural and residential land uses, has been protected through both outright acquisition and conservation easements.

Other methods to preserve open space can be considered in addition to outright purchase of land. Several more affordable examples of open space preservation practices include the purchase or dedication of an easement that limits use of the parcel in exchange for a tax abatement or as a condition of development approval, and the purchase of development rights for a property.

In Lake County, the Forest Preserve District, local park districts and townships have prevented millions of dollars of flood damage through the foresighted acquisition of floodplain. The Lake County Forest Preserve District alone owns 6,784 acres of land adjacent to the Des Plaines River, 1,052 acres along the Skokie, Middle and West Forks of the North Branch of Chicago River, and 302 acres adjacent to the Fox River.



The Des Plaines River Trail is an excellent example of floodplain open space that serves the entire community.

Parks and golf courses follow the course of the Skokie River providing areas of floodplain storage. Private not-for-profit organizations are also active in preserving open space in Lake County. These groups include Lake Forest Openlands, Lake Bluff Openlands, Liberty Prairie Conservancy and the Lake County Land Conservancy.

Considered Improvements

- An open space network should be designated and mapped based on the information collected in data layers for the area-wide conservation and development map. Soils, historic, archeological or cultural sites and recreation potential should also be added as considerations for designation of land in the open space network.
- The open space network map should be incorporated into Forest Preserve District and park district land acquisition plans/programs.

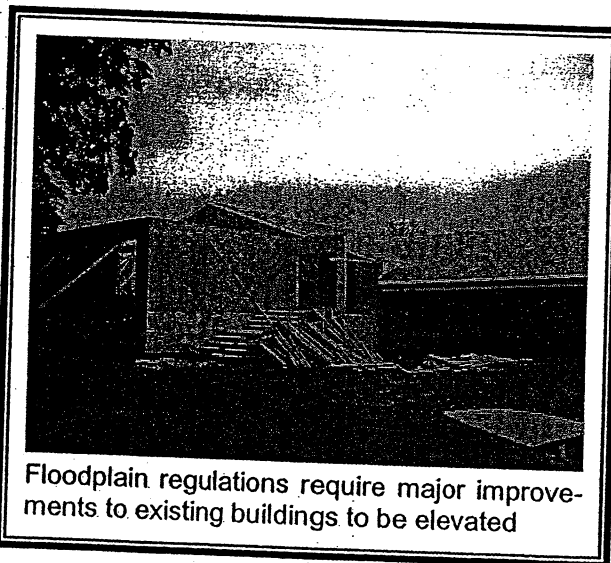
- The open space network map should be adopted by all municipalities and other units of county government and should be widely distributed to both government and private open space organizations.
- Develop system to coordinate activities of LCFPD, CDBG program, park districts, & public works to identify properties for acquisition and structure removal or relocation. (Develop map overlay of CDBG qualified areas over floodplains, Flood Problem Areas and existing park district/FPD properties with open space network.)
- Aggregate all existing 1 or 2-foot topography and cross-section information available for Lake County from county, municipal and state and federal government agencies.

Floodplain regulations

In addition to zoning ordinances, regulations that restrict construction in floodplains are usually found in one or more of the following documents: subdivision ordinances, building code, and/or a separate "stand alone" floodplain ordinance. If the zoning for a site allows a structure to be built, then the applicable subdivision and building regulations will impose construction standards to protect buildings from flood damage and prevent the development from aggravating the flood problem.

Subdivision ordinances specifically govern how land will be subdivided into lots, and regulate standards for infrastructure provided by the developer including roads, sidewalks, utilities, stormwater detention, storm sewers and drainage ways. Building codes should establish flood protection standards for all structures.

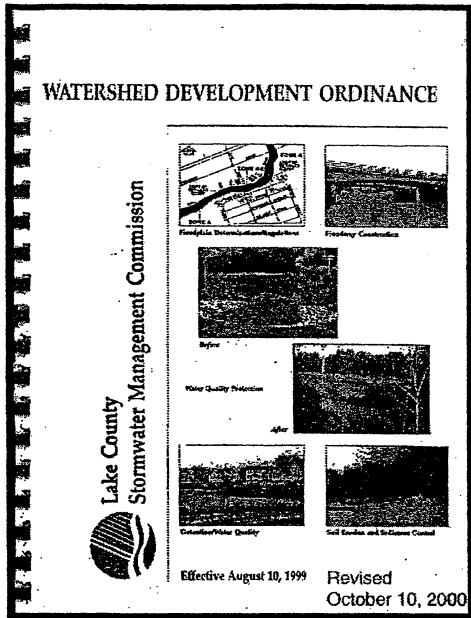
The National Flood Insurance Program sets the minimum floodplain regulation requirements for local flood plain ordinances, subdivision regulations and building codes. Communities are strongly encouraged to adopt local ordinances that are more stringent than state or federal criteria and based on local watershed conditions in order to adequately protect their residents from flood damage. Adoption of more stringent local criteria is an important factor of safety for areas highly prone to flooding, and for areas with inaccurate floodplain maps.



Floodplain regulations require major improvements to existing buildings to be elevated

For example: some areas in Lake County have floodplain maps that are based on hydrology and hydraulic studies that were done 20 or more years ago. These floodplain maps do not consider recent urbanization in the

watershed and therefore do not reflect the present flood hazard. More stringent local regulation may also address some floodplain uses, that while allowed under state and federal programs, result in significant local damage such as garages, roads, parking lots etc..



In response to the county's flood hazard, a Watershed Development Ordinance (WDO) was adopted in 1992. The WDO provides consistent, uniform, minimum stormwater management standards and floodplain regulation of new development across county jurisdictions. Standards in the WDO reflect state and federal requirements for floodplain regulation and address specific Lake County flooding problems that occur in depressional storage areas and in unmapped floodplains/floodways.

To address flooding in unmapped floodplains, the WDO definition of a regulatory floodplain includes smaller tributaries subject to more than one square mile of drainage, and depressional areas, not associated with streams, that have a storage volume of .75 acre feet or more when inundated by the base flood.

Even with the more comprehensive definition of "floodplain" provided in the WDO, many floodprone areas of the county are not identified due to a lack of accurate topography. Although 1 or 2 foot topography has been collected for some limited areas of the county as subwatershed studies are done, most of the county has to rely on the United States Geological Survey 10 foot topography, which is not detailed enough to accurately reflect surface flow in the relatively flat landscape of Lake County.

Many Lake County municipal ordinances exceed the WDO standards in one aspect or another. The WDO insures minimum requirements are met, but does not prohibit individual communities from implementing stricter standards to protect their property owners from flooding.

Considered Improvements

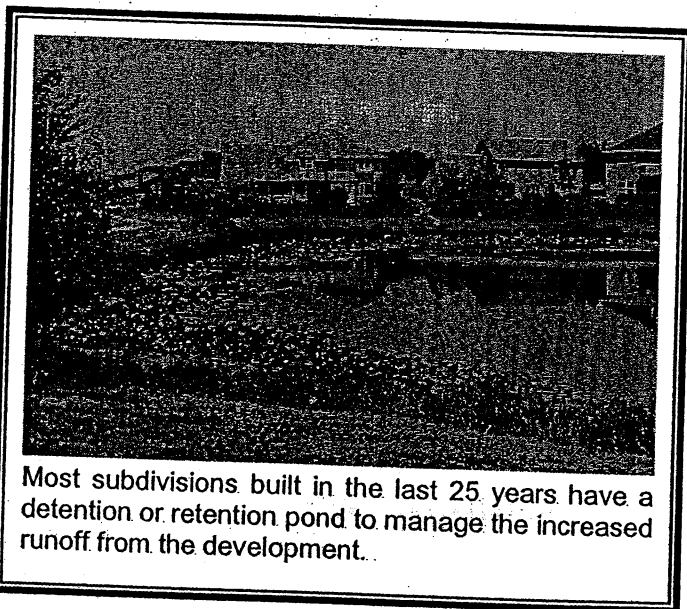
- Acquire 1 or 2 foot topography and cross sections for areas of the county not currently covered with up-to-date hydrologic and hydraulic data from previous subwatershed studies.
- Complete hydrology and hydraulic (H&H) modeling for all Lake County watersheds in order to adequately identify floodplain boundaries.

- Complete an accurate floodplain map for all Lake County watersheds and submit to FEMA for adoption.
- Establish a regular schedule and funding mechanism for keeping H&H models and floodplain mapping up-to-date.
- Coordinate/incorporate SMC review of development proposals early in the process.
- County and communities establish floodplain/floodway/known flood problem areas tag for address files to reference for development review and permit issuance.

Runoff reduction

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when urban development covers the land surface with impervious cover such as roads, parking lots and buildings. Rainfall no longer able to infiltrate the soil runs off the land. The cumulative result is a greater volume of surface runoff being transported to floodplains. For this reason, unconstrained watershed development overloads a community's drainage system and aggravates downstream flooding.

Effective stormwater management policies require developers to build detention or retention basins to minimize increases in runoff rates and volumes in comparison to pre-development conditions. Since detention only controls runoff rates and not volumes, there is a need for other measures to enhance the infiltration of stormwater. Run-off reduction measures such as replacing curb/gutter, storm sewers and pavement with vegetated swales, filter strips, infiltration trenches, and permeable paving blocks are measures that should be added to standard detention practices to improve stormwater infiltration.



Most subdivisions built in the last 25 years have a detention or retention pond to manage the increased runoff from the development.

Development designs that preserve the natural drainage system (including depressional storage areas) and native vegetation, and minimize pavement and other impermeable surfaces, will reduce increases in runoff from developed sites.

The Lake County Watershed Development Ordinance (WDO) includes detention requirements that control the rate of stormwater release from developments. The allowable release rate is the determinant of the volume of stormwater that needs to be detained. The WDO specifies a uniform release rate for the entire County regardless of watershed. It is anticipated that as comprehensive watershed studies are completed, recommendations for future refinements will include watershed specific release rates.

Although the WDO addresses the rate of stormwater release, it does not effectively regulate the increased volume of runoff. Controlling the increased rate of runoff through detention may reduce flooding impacts in small watersheds, but detention has little effect on flooding along large rivers such as the Fox or Des Plaines. The increased volume of runoff ultimately collects in these large river basins resulting in higher flood elevations.

Considered Improvements

- Strengthen application of the runoff volume reduction hierarchy in the WDO.
- The UDO and municipal zoning and subdivision ordinances should incorporate strong incentives for conservation developments that minimize impervious surface and enhance the absorption potential and/or storage capacity of a developed site. A range of density options should be adopted, with full density allowed only for conservation design developments. Incentives, such as a range of density options, should be tied directly to compliance with the runoff reduction hierarchy of the WDO.
- Pre-development runoff rates should be determined for each subwatershed and incorporated into the WDO requirements for regulation of runoff rates and volume post-development.

Drainage system maintenance.

The drainage system may include detention ponds, stream channels, swales, ditches and culverts. Drainage system maintenance is an ongoing program to clean out blockages caused by an accumulation of sediment or overgrowth of weedy, non-native vegetation or debris, and remediation of streambank erosion sites.

“Debris” refers to a wide range of blockage materials that may include tree limbs and branches that accumulate naturally, or large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales or detention basins. In addition to sediment, debris and weedy vegetation removal, drainage maintenance can also involve using best

management practices (BMPs) to stabilize eroding shorelines or streambanks. Maintenance of detention ponds may also require revegetation or repairs of the restrictor pipe, berm or overflow structure.

Maintenance activities normally do not alter the shape of the channel or pond, but they do affect how well the drainage system can do its job.

In Lake County, parks, public works or highway departments, the Forest Preserve District or the drainage districts where rights-of-way are established or easements have been granted generally perform channel maintenance activities. Channel maintenance and restoration have also been a part of several river/stream projects such as the pool/riffle installation of the Waukegan River restoration project, and streambank stabilization using bioengineering along sections of Flint Creek in Barrington and Lake Zurich and the West Fork of the North Branch of the Chicago River in Deerfield.

In the case of detention ponds, generally a property owners association is responsible for maintenance at residential developments. Detention ponds on public properties are maintained by the appropriate government jurisdiction.

Lake County allocated money for fiscal year 1998 to establish a drainage improvement fund for small projects in unincorporated Lake County. The Lake County Planning and Development Department (P&D) is establishing the procedure for expenditure of these funds.

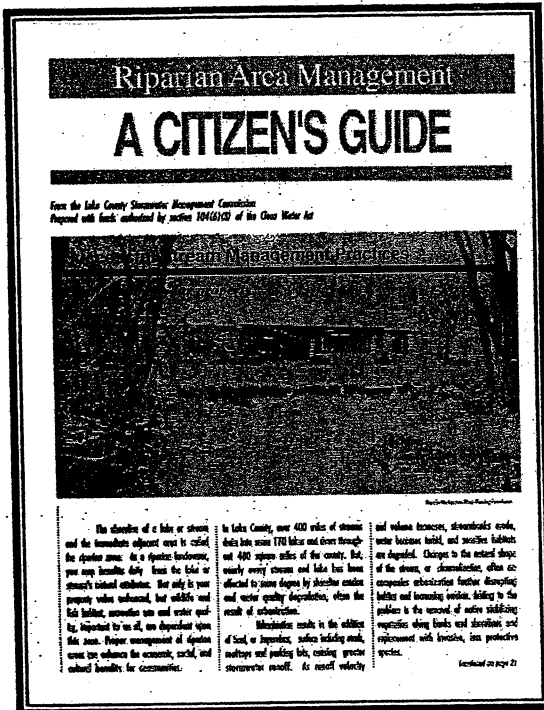
In addition to this fund, Watershed Management Board (WMB) and Community Development Block Grant (CDBG) funding have been used for drainage system improvements in the past. WMB funding is administered by the SMC and awarded on a competitive basis as 50% cost-share funding for projects sponsored by communities. CDBG funds are administered by the P&D based on recommendations by the Community Development Commission.

There is currently no coordinated program or maintenance standards established at the county-level to consistently perform on-going drainage maintenance. Maintenance is typically done on an as-needed basis in response to problems or complaints about blockages or erosion. In many cases property owners must consent to the maintenance program. This may require legal negotiations to obtain maintenance easements.



A drainage maintenance program removes accumulated debris to prevent flooding from smaller, more frequent storms.

In Illinois, the responsibility for drainageway maintenance on private property, when no easements have been granted, is with the individual private property owner. This generally results in very little maintenance being accomplished.



The Lake County Stormwater Management Commission (SMC) has developed "A Citizen's Guide for Riparian Area Management", which educates landowners about debris removal and riparian landscaping. SMC anticipates adopting stream maintenance standards in the future to provide guidance and consistency for maintenance in Lake County.

Considered Improvements

- Develop, adopt and implement protocol for drainage system maintenance standards county-wide (waterways, swales, detention basins, levees, reservoirs).
- Create Special Service Areas so townships can collect utility fees to maintain unincorporated drainage systems. (Should not be left to maintenance by homeowners associations.)

Real estate disclosure

Many times after a flood, flood victims say they would have taken steps to protect themselves if only they had known they had a floodprone property. Three regulations, one federal and two state, require that a potential buyer of a parcel be told of any flood hazard.

Federal law: Federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured by an insurable building that the property is in a floodplain as shown on the Flood Insurance Rate Map (FIRM). Flood insurance is required for buildings located within the 100 year floodplain if the mortgage or loan is federally insured. This program does not apply to floodprone areas that are not mapped on the FIRMs. Floodprone areas that are frequently not mapped include the floodplains of smaller channels and many depressional areas. Depres-

sional area flooding is a significant The use of older flood studies in rapidly developing areas also results in outdated floodplain maps that do not reflect the actual flood risk.



Illinois Compiled Statutes: Chapter 55, Section 5/3-5029 requires that all subdivision plats must show whether any part of the subdivision is located in a Special Flood Hazard Area.

Illinois Residential Real Property Disclosure Act: This law, which went into effect on October 1, 1994, requires a seller to tell a potential buyer if the seller is aware of any flooding or basement leakage problem, if the property is located in a floodplain, or if the seller has flood insurance. The law is not wholly reliable because the seller must be aware of a problem and willing to state it on the disclosure form. Due to the sporadic occurrence of flood events, a property owner may legitimately not be aware of potential flooding problems with a property being sold or purchased.

Considered Improvements

- Educate and provide Flood Hazard Areas and wetland maps to realtors to improve real estate disclosure.
- Tie flood hazard areas into township tax files for disclosure purposes.

Property Protection

Property protection measures are used to modify or remove buildings subject to flood damage rather than to keep floodwaters away. Because of the widespread extent of flood damage caused by shallow, low velocity flooding in Lake County, traditional flood control structures such as levees and reservoirs are generally not economically justifiable in most areas. Individual property protection measures are usually the most preferred and cost-effective flood mitigation measures in these circumstances. Many property protection measures do not affect a building's appearance or uses, making them particularly appropriate for historical sites and landmarks.

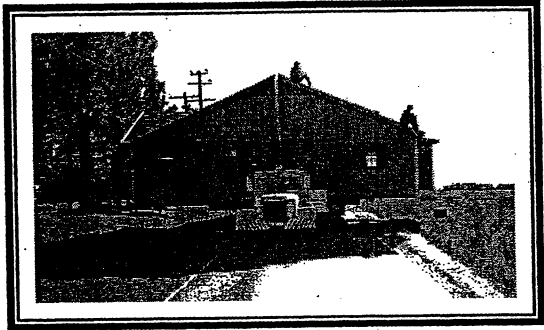
Property Protection Measures

- ✓ Building relocation
- ✓ Building acquisition
- ✓ Building elevation
- ✓ Barriers
- ✓ Floodproofing
- ✓ Sewer backup protection
- ✓ Septic system modification
- ✓ Insurance

Although most property protection measures are paid for and implemented by individual property owners, there is increasing government interest and cost-share funding available for building relocation and acquisition, which are seen as permanent solutions to flood damage. While property protection is viewed as the property owner's responsibility, local governments can actively support and promote private efforts by providing technical assistance and incentives.

Building relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier structures, such as those made of brick, and for large or irregularly shaped buildings. Building relocation is generally cost-effective where flooding is relatively severe and/or frequent. Buildings that have suffered structural damage or contamination from frequent or long duration flooding should not be considered for relocation.



While relocation is typically the responsibility of the building owner, government-sponsored loans or grants may be available for cost-share. Communities and county-wide agencies could play a greater role in building relocation by improving public and local official awareness of this option, identifying and prioritizing buildings or properties well-suited for relocation, and by locating potential cost-share funds to assist individual property owners.

Considered Improvements

- Identify and prioritize buildings located in floodplains or flood hazard areas that would physically and economically qualify for relocation.
- Identify potential relocation sites at the community level based on cost effective mitigation.
- Identify potential cost-share funding for structural relocation, and for restoration and maintenance of vacant property.
- Promote building relocation as a mitigation option in public information activities geared to floodplain property owners.

Acquisition

Like relocation, acquisition ensures that buildings in a floodprone area will cease to be subject to damage. The major difference is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to an appropriate public use such as a park. Acquiring and clearing buildings from the floodplain is not only the best long-term flood protection measure, it also is a way to convert a problem area into a community asset that can provide environmental and recreational benefits.

The Village of Gurnee has purchased properties when they come up for sale in the floodway. In 1997, the Stormwater Management Commission began coordinating the county's first acquisition projects in Sturm Subdivision and William's Park, two of the most repetitively flood damaged locations in the county. The acquisition is being cost-shared with Federal Emergency Management Agency (FEMA) post-disaster mitigation funds through the Illinois Emergency Management Agency (IEMA). The buyout involves eligible willing sellers only and is funded with 75% federal dollars and 25% local.



More communities and county-wide agencies could get involved in acquisition by: improving public awareness of this option; budgeting funds for the 25% match for state and federal funding; establishing guidelines for determining when acquisition is preferable to flood control or flood proofing; and by prioritizing properties for purchase. To achieve maximum benefits from this type of public investment, acquisition and land reuse should be a component of a community's redevelopment plan, and be incorporated as a strategy in parks and capital improvement plans.

Considered Improvements

Establish a county buyout program that:

- Develops guidelines for determining when acquisition is cost-effective for mitigation
- Prioritizes repetitively flooded buildings/areas for acquisition
- Targets property owners in priority areas with information on the acquisition program
- Provides a pool of county and community local cost-share funds (based on planning jurisdiction) to match federal and state dollars
- Coordinate buyout program with local and countywide land acquisition programs

Building elevation

Raising a house above the flood level is the best way to protect a structure that cannot be removed from the floodplain. The structure is elevated on a foundation or piers so that the lowest floor is above the base flood elevation. When flooding occurs, water levels stay below the main floor, causing no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it, and can be less disruptive to a neighborhood. Commonly practiced in floodprone areas nationwide, this

protection technique is required by law for new and substantially damaged residences located in a 100 year floodplain.



This house was elevated one foot above the base flood elevation of the Des Plaines River

Although flood damage can be reduced significantly or eliminated through building elevation, there are some limitations to remaining in a flood prone location. While the building itself is elevated sufficiently to be protected from flood damage, flooding may isolate the building making it inaccessible. In addition, flood waters can result in a loss of utility service or septic use in flooded areas making the building uninhabitable even though it isn't damaged, and pollutant contamination in floodwaters will still threaten health and safety.

Considered Improvements

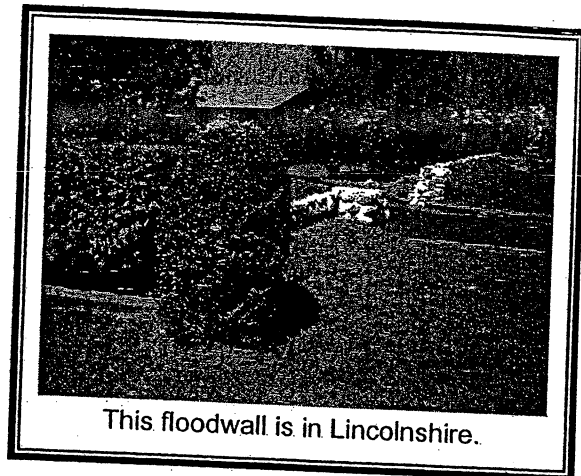
- Identify all structures in floodprone areas and set up a database by address for county and municipal use in communicating with property owners.
- Work with property owners to collect first floor elevations and conduct flood audits to determine if building elevation is a practical and affordable mitigation measure for those buildings that do not qualify for acquisition or relocation programs.
- Use public information campaign to reach affected property owners with information on building elevation and other mitigation measures.

Barriers

Constructing barriers, such as floodwalls and berms, can keep floodwaters from reaching a building. Berms are commonly used in areas subject to shallow flooding. Not considered engineered structures, berms are made by regrading or filling an area. Low floodwalls may be built around stairwells to protect the basement and lower floor of a split-level home.

By keeping water away from the building walls, the problems of seepage and hydrostatic pressure are reduced.

Use of floodwalls and berms must also include a plan to install drain pipes and/or sump pumps to handle leaks and water seepage through or under the barrier, and to get rid of water that may collect inside the barrier. Care must be taken in the design, location and installation of berms or floodwalls to insure that floodwaters are not inadvertently pushed onto an adjacent property.

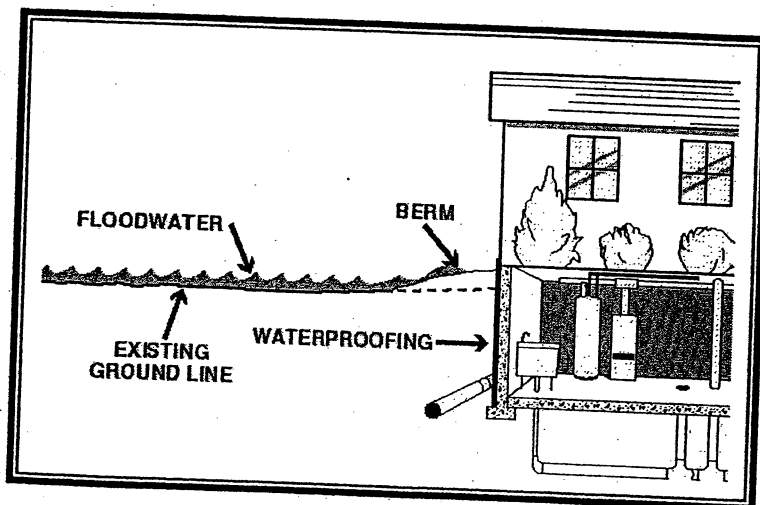


This floodwall is in Lincolnshire.

Floodproofing

Floodproofing covers measures that provide either wet floodproofing or dry floodproofing. In areas where there is shallow flooding, dry floodproofing measures can be used to prevent water from entering some buildings. A wet floodproofing strategy will allow water to enter the building, but moves damageable belongings, appliances and utilities out of harm's way.

Dry Floodproofing: Dry floodproofing is a combination of practices that are used to seal a building against floodwaters. Walls, floors and all openings must be sealed and made watertight. Buildings with crawlspaces generally cannot be dry floodproofed because water can seep under walls into the crawlspace. However, buildings on slabs and buildings with basements can benefit from dry floodproofing.



Dry Floodproofing

Buildings on slab

- ✓ Walls are coated with water-proofing compounds or plastic sheeting.
- ✓ Openings, such as doors, windows, sewer lines and vents, are closed either permanently, with removable shields, or with sandbags.

Buildings with basements

- ✓ Waterproofing compound is applied to the walls before fill is placed against the side of the house.
- ✓ Installation of a subsurface drain tile and sump pumps is a must to handle water that will naturally seep through the fill.
- ✓ Surface water is kept away from the walls with backfill (see illustration).

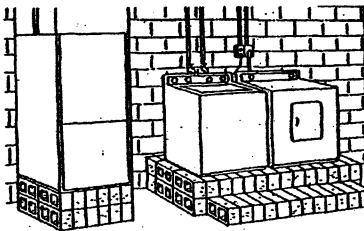
A structural engineer should be consulted to design the dry floodproofing measures. Because of the need to address hydrostatic pressure in the design, it can be a very difficult business.

Water standing on the ground outside a basement will quickly build up pressure against the basement walls, putting the equivalent pressure of six to seven feet of water on the walls and floor. Most walls and floors are not built to withstand hydrostatic pressure of more than three feet of water. As a result, if a dry floodproofed structure is not sufficiently reinforced, basement walls and floors can become cracked, buckled or broken by the pressure of floodwater.

Wet Floodproofing: Wet floodproofing provides damage protection from floodwaters that cannot be kept out of a building. It is a relatively simple means of making sure that nothing gets hurt when floodwaters get in. Wet floodproofing includes some of the least expensive and easiest mitigation practices to install.

Wet Floodproofing

- ✓ Everything subject to damage by water or sediment is moved to a higher level or out of the building. For example, the electrical panel and the furnace should be relocated to an upper floor.
- ✓ Where flooding is not expected to be deep, items needing protection may be placed on platforms or blocks.



- ✓ Lighter items, such as lawn furniture or bicycles, are evacuated after a flood warning is issued.

Wet floodproofing approaches range from moving a few valuable items to a higher floor to totally rebuilding the floodable area. At the very least, several low-cost steps can be taken to wet floodproof a structure. Simply moving furniture and electrical appliances out of the floodprone area of the building can prevent thousands of dollars in damages.

One advantage of using wet floodproofing is that no matter how little is done, flood damage will be reduced. Wet floodproofing measures work wherever there is a level above the flood zone to which items can be relocated. It generally does not work for one-story houses where living areas get flooded. An advantage of using wet floodproofing vs. dry floodproofing, is that by allowing water in the structure, the danger of wall collapse due to uneven pressure is alleviated.

Considered Improvements

- Develop property-owner incentives for floodproofing. An example to consider is a one-time property tax deduction for a portion of floodproofing costs.
- Establish and disseminate guidelines for determining what mitigation measures are appropriate under various circumstances.
- Provide incentives for training of appropriate municipal and county staff on floodproofing of new and existing floodprone structures.

- Establish or re-designate an existing "high profile" floodproofing technical position at the county level to advise/train county and municipal engineers and code enforcement and building inspectors on how to recommend appropriate floodproofing measures, and how to conduct flood audits.

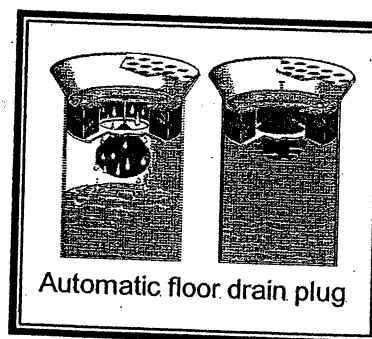
Sewer backup protection

Basement flooding can occur when the sanitary system overloads with stormwater and backs sewage up into the basement through the sanitary line. Even when sanitary and storm waters are carried in separate pipes, sewer backup can occur when cross connections between the storm and sanitary sewers exist, or if there are infiltration or inflow problems into the lines.

Houses which have downspouts, footing drain tile, and/or a sump pump connected to the sanitary sewer service may be inundated when heavy rains overload the system. In addition to these sources, sanitary lines can also be inundated by stormwater by way of runoff infiltration into old leaky pipes or where the sanitary manholes are not properly sealed. Several Lake County communities experience very high sewage flows following heavy rain events. As in the case of Wauconda, some wastewater treatment plants cannot adequately treat the heavy volume of combined stormwater and sewage, so the plant is by-passed and sewage is discharged directly to surface waters untreated.

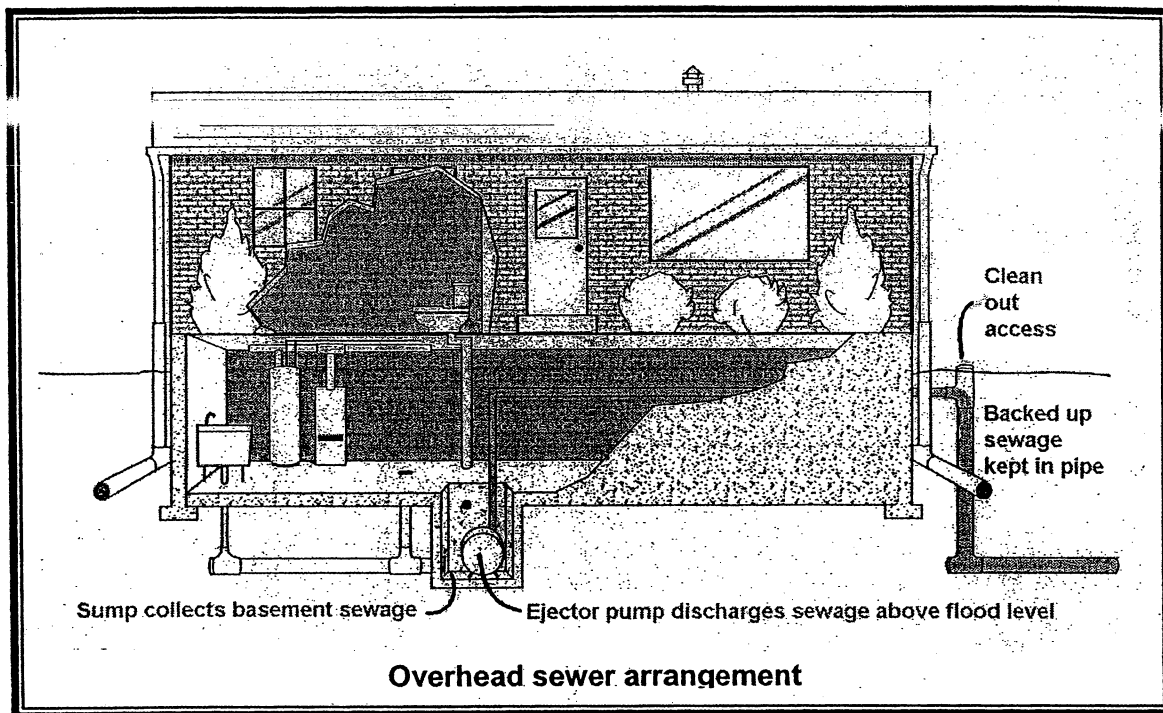
If allowed by the local code, sump pumps, downspouts and footing drains should be disconnected from the sanitary sewer line and the rain and groundwater directed out onto the ground, away from the building. The solution to stormwater overload of the sanitary system also includes the need for timely maintenance of sanitary lines, repairing or replacing pipe where it leaks, and upgrading old wastewater treatment facilities that are inadequate for the existing level of use.

Until sanitary infiltration is fixed, a property owner may use four approaches to protect sanitary sewer openings from backup. Floor drain plugs or floor drain standpipes can be installed to keep water from flowing out of the floor drain into the building. However, these may not be effective if water gets deep enough in the sewer system to flow out of the next lowest opening, which is likely to be a toilet or utility sink.



Automatic floor drain plug

Overhead sewers and backup valves are more expensive, but more secure for this circumstance. An overhead sewer keeps water in the sewer line during a backup. A backup valve allows sewage to flow out, while preventing backups from entering the building.



Considered Improvements

- Develop action plan to identify and remedy illicit hook ups and sewer infiltration that maps and prioritizes problem areas for remediation. This can be done as county coordinated community program in conjunction with NPDES Phase 2 requirements.
- Provide technical assistance at county level to municipalities and property owners for mitigation alternatives.

Septic system modification

In Lake County, septic failure is a common secondary result of flooding. Having septic tanks pumped as needed during periods of ponding, soil saturation or following a flood is one method of maintaining the usefulness of septic systems. In cases where the size of a single septic tank is inadequate, a second tank should be installed.

A second strategy to improve septic usefulness during high water periods would be to install an alternative system. The Wisconsin Mound septic system is constructed in soil, gravel and sand layers above the existing grade. The Wisconsin Mound may function better than traditional systems during high groundwater periods, but even their usefulness is limited under flood conditions.

Considered Improvements

- Increase level of county inspection authority and technical support for evaluating and improving septic system effectiveness.
- Focus on measures to improve septic system performance in public information efforts targeted to property owners in flood problem areas identified as having septic failure.

Insurance

Insurance does not prevent flooding or flood damage; it helps an owner protect his/her property investment by paying for repairs and replacement of items damaged in a flood. While a typical homeowner's insurance policy does not cover a property for flood damage, flood insurance coverage is available through the National Flood Insurance Program, as is additional basement backup insurance.

National Flood Insurance: In Lake County forty-three municipalities and the County participate in the National Flood Insurance Program (NFIP). Flood insurance is required as a condition of certain types of federal aid and most bank loans and mortgages for buildings located in the 100 year floodplains identified on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps.

While the NFIP requires flood insurance for those at greatest risk, there are several weaknesses in the program. Many of the buildings subject to flooding in Lake County are not located in the 100 year floodplain as identified on the FEMA maps. In addition, many policy holders drop flood insurance following a period of dry years or after their mortgage is paid off, and/or do not buy enough insurance to cover their total risk (for instance for building contents).

In spite of the federal law, it is estimated that fewer than 1 in 4 floodplain properties are covered under NFIP (Flood Hazard Mitigation in Northeastern Illinois, 1995). A full 25% of NFIP claims are for flood damage to buildings located outside of the 100 year floodplain (the insurance requirement zone).

NFIP Status: Lake County					
	Policies			Claims since 1978	
	Floodplain	Outside	Total	Number	Dollars
Municipalities	2,178	955	3,133	943	\$4,523,000
Unincorporated	599	204	803	289	\$1,310,000
Total	2,777	1,159	3,936	1,232	\$5,833,000

Figures are as of December 31, 2000

Flood insurance is available for anyone, regardless of building location, and premiums are lower if your structure is not in a mapped floodplain. For this reason, if there is any risk of flood damage to a property, it is prudent to have flood insurance.

There are ramifications for not having insurance required by the NFIP when future flood damage occurs. If property owners who were required to purchase insurance as a condition of receiving disaster assistance for a previous flood dropped the policy, they would lose their right to any future disaster assistance. In addition, under-insured public buildings will have the amount of flood insurance they should have carried deducted from any disaster assistance they may be eligible for after a flood.

Basement backup insurance: The NFIP will cover seepage and sewer backup for an additional deductible provided there is a general condition of flooding in the area that was the proximate cause of the basement getting wet. Several insurance companies offer coverage for damages incurred should a sump pump fail or sewer line back up. Most exclude damage from surface flooding that would be covered by the NFIP.

Natural Resource Protection

Natural Resource Protection

- ✓ Wetland protection
- ✓ Erosion and sediment control
- ✓ Best management practices

Natural resource protection measures serve to restore or preserve the natural functions of the floodplain and other components of the watershed storage and drainage system. These measures are implemented by a variety of public and private parties ranging from local park districts, forest preserves and regulatory agencies to land developers and farmers.

Wetland protection regulations

Wetlands are usually found in floodplains or depressional areas. They provide numerous natural and beneficial functions that warrant protection. Most wetlands in Lake County are subject to the US Army Corps of Engineers' (Corps) Section 404 (Clean Water Act) regulations. Corps' permits are required for projects that will excavate or place fill or dredged materials in a wetland. Indirect impacts to wetlands from adjacent development are not covered under the 404 regulatory program. Before a 404 permit is issued, project plans are reviewed by several agencies including the US Fish and Wildlife Service and the Illinois Environmental Protection Agency.

Local wetland programs are important for addressing gaps in the federal regulations, particularly for smaller wetlands, unregulated activities, and indirect hydrologic impacts. Local wetland programs can require undisturbed buffers be maintained around wetlands.

Lake County does not have a wetland regulatory ordinance, but wetlands are afforded some aspects of protection through the Zoning and Watershed Development Ordinances (WDO). Although wetlands regulatory provisions are written into the WDO, they are not effective until such time as the Stormwater Management Commission assumes permit review authority from the Corps for Section 404 general permits. To help fill the gap in current regulatory programs, several Lake County municipalities have adopted specific wetland ordinances, including Barrington Hills, Mundelein and Third Lake.

Wetlands

- ✓ Store large amounts of floodwater
- ✓ Reduce downstream flood peaks
- ✓ Reduce flood velocities
- ✓ Protect shorelines from erosion
- ✓ Filter water making it cleaner
- ✓ Are groundwater recharge and discharge sites
- ✓ Provide habitat for species that cannot live or breed anywhere else

Considered Improvements

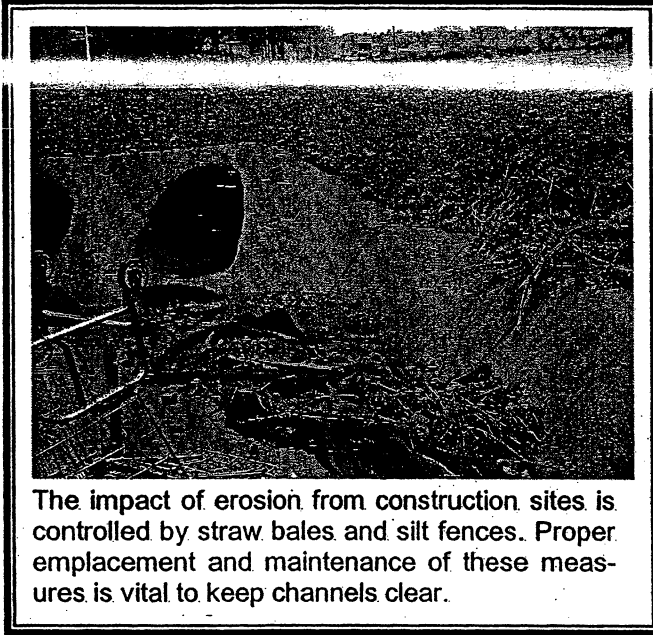
- Adopt amended wetland regulatory portion of the Watershed Development Ordinance that includes a goal of no-net-loss of wetlands.
- Require mitigation or fee-in-lieu of mitigation for all wetland impacts associated with development.
- Establish county program to restore wetlands for mitigation.

Soil erosion and sediment control.

As rain hits the ground, especially where there is bare soil as on farm fields and at construction sites, soil is picked up and washed downstream. This erosion of soil produces sediment that may end up in waterways far from the eroded area. Erosion also occurs along streambanks and shorelines as the volume and velocity of flow or wave action destabilize and wash away the soil.

Sediment suspended in the water tends to settle out where flowing water slows down. It can clog storm sewers, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands.

There are two principal strategies used to implement these mitigation measures: 1. minimize erosion and 2. control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing best management practices (BMP).



If erosion occurs, BMPs are used to capture sediment before it leaves the site. Silt fence, sediment traps and vegetated filter strips are examples of BMPs commonly used to control sediment transport.

Countywide minimum standards for soil erosion and sediment control are a significant component of the Watershed Development Ordinance (WDO). Weaknesses in the regulatory program include:

- Inconsistency in interpretation and application of WDO requirements by all of the certified communities in the county;
- Inadequate inspection of soil erosion and sediment control measures in the field by some communities; and,
- Lack of consistent enforcement of the WDO by all certified communities.

In addition to the WDO requirements, several communities have their own soil erosion/sediment control ordinances. According to a 1990 survey for the Comprehensive Stormwater Management Plan, 7 municipalities had separate sediment and erosion control ordinances, and 23 municipalities had adopted erosion and sediment control provisions in other ordinances or building code documents.

Considered Improvements

- Improve timing and performance for soil erosion and sediment control practices at the county and community level. (Provide guidance on consistent interpretation and better enforcement of WDO requirements.)

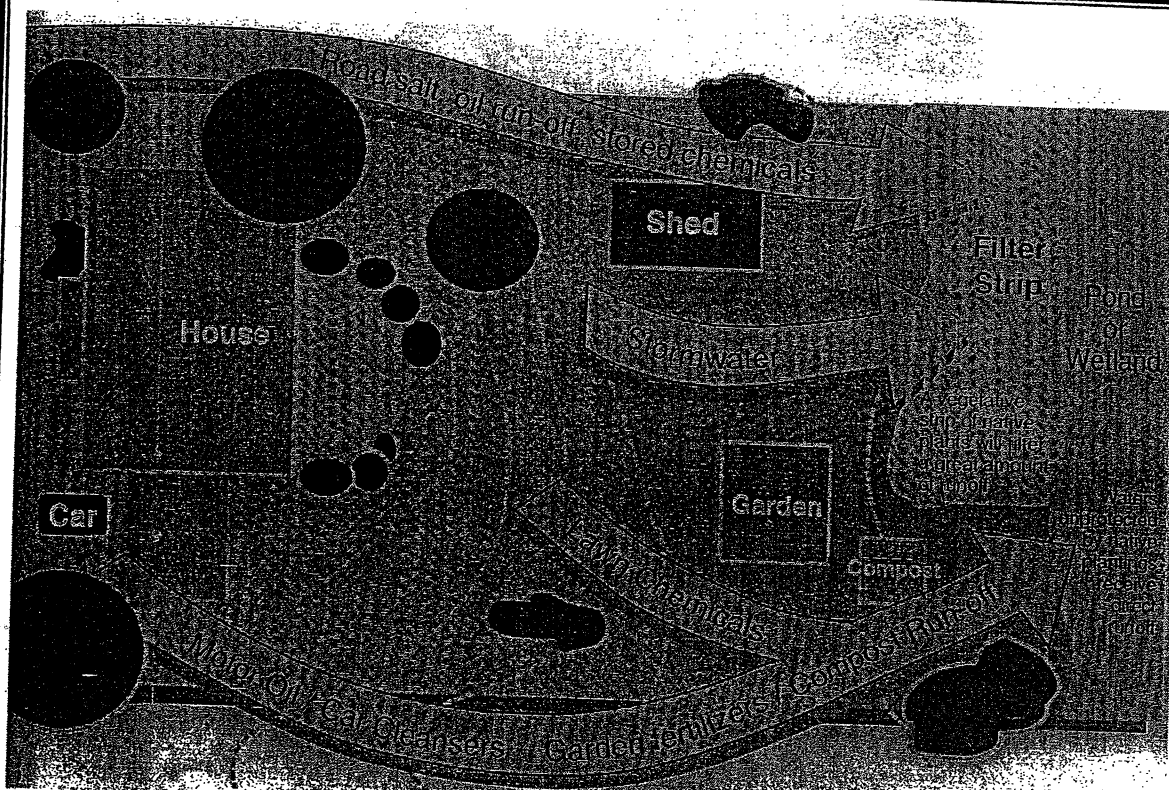
Best Management Practices

The term "best management practices" refers to design, construction and maintenance practices and criteria for stormwater management that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources and capture pollutants (including sediment). In addition to preventing increases in downstream flooding and minimize water quality degradation, BMPs preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple use of drainage and storage facilities.

Effective stormwater management policies require developers to build detention or retention basins. Since detention only controls runoff rates and not volumes, there is a need for other BMPs to enhance the infiltration of stormwater. These include measures such as replacing curb/gutter, storm sewers and pavement with vegetated swales, filter strips, infiltration trenches, and permeable paving blocks.

BMP recommendations for construction sites include:

- Minimizing impervious surfaces,
- Preserving natural or grassy areas along streams as filter strips,
- Regional stormwater detention,
- Retaining depressional storage areas and natural drainageways; and
- Streambank stabilization.



Grass filter strips are BMPs that clean stormwater runoff and improve water quality.
Source: *Living With Wetlands, A Handbook for Homeowners in Northeastern Illinois*

In watersheds with agricultural land use, subsurface drainage and row cropping can speed runoff onto downstream properties. Because a large amount of farmland is bare during fall and spring when the highest rainfall occurs, stormwater runoff can carry large amounts of sediment that may fill and block downstream drainage facilities. Slowing runoff on the way to a drainage channel increases infiltration into the soil and controls the loss of topsoil and resulting sedimentation. BMPs that slow down runoff and sediment transport include vegetative buffers, grassed waterways, terraces, contour plowing, crop residue and no-till farm practices.

Watershed management is coordinated through the Lake County Stormwater Management Commission (SMC). To meet watershed management needs, SMC has developed a Technical Reference Manual (TRM) that details BMPs appropriate for implementation to meet the Watershed Development Ordinance (WDO) requirements.

In addition to administration of the WDO, SMC is also responsible for watershed planning. Watershed management plans that address water quantity (flooding), water quality, natural resource protection, and recreation - multi-objective floodplain management - have been developed for several subwatersheds including Flint Creek and Mutton Creek. Current watershed planning efforts include the North Branch of Chicago River, Squaw Creek, Sequoit Creek and Slocum Drain.

Considered Improvements

- Improve wetland protection provisions in the WDO, i.e.: appropriate use restrictions on wetlands and wetland buffers (require deed restrictions on wetlands and buffers incorporated into, or adjacent to, developments); increase the minimum width of wetland buffers and incorporate buffers on map identifying deed restricted areas.
 - Municipal and county landscaping and weed control ordinances should be adapted to allow and encourage landscaping with deep-rooted native vegetation.
 - Establish mandatory riparian buffers along all open streams.
 - Coordinate/incorporate SMC review of development proposals early in the process to insure appropriate BMPs are incorporated into development designs.
 - Better monitoring and enforcement of BMP performance.
 - Complete watershed assessments and plans that incorporate specific BMPs based on watershed condition for all 26 of Lake County's sub-watersheds.
-

Emergency Services

Emergency services measures protect people during and after a flood. The primary responsibility for protecting lives and property from flood hazards lies with the local government. All counties in northeastern Illinois and many cities and villages have emergency management offices to coordinate warning, response, and recovery during a disaster.

Lake County Emergency Management Agency (LCEMA) is operated through the County Sheriff's Department of Emergency Services with offices located in Libertyville, Illinois. The Lake County EMA coordinator is the Emergency Services Coordinator (ESC) for Lake County. At the state level, local EMA programs are coordinated by the Illinois Emergency Management Agency (IEMA).

Emergency Services Measures

- ✓ Flood threat recognition
- ✓ Flood warning
- ✓ Flood response
- ✓ Critical facilities
- ✓ Health & safety maintenance

In Illinois all counties and those communities with populations greater than 10,000 are required by law to have a state-accredited emergency services and disaster program. Municipal EMA programs respond to disaster situations that occur in their corporate boundaries. The LCEMA is responsible for all unincorporated areas in the county and unincorporated communities lacking an EMA program.

Flood threat recognition

The first step in responding to a flood is knowing that one is coming. A flood threat recognition system provides early warning to emergency managers. A complete system measures rainfall, snow conditions, soil moisture, and stream flows upstream in order to calculate the time and height of the flood crest downstream.

The National Weather Service (NWS) tracks precipitation, monitors river stages and issues flood crest forecasts during potential flood situations. The NWS continuously relays weather information to Lake County on 162.55 Mhz.

The flood crest forecasts, based on the existing river stage and expected precipitation, estimate the potential peak flood height and the time it will occur. However, this is done only for four locations on the County's two largest rivers (see box).

NWS Forecast Points

River Site	Flood stage
Des Plaines River	
Russell	7
Gurnee	7
Des Plaines	5
Fox River	
Algonquin	3

In addition, the NWS will often issue a "flash flood watch" for urban areas, a notice that the amount of rain expected will cause ponding and other flooding along small streams.

LCEMA receives flood crest forecasts over the NWS weather wire and is responsible for disseminating that information to affected communities and critical care facilities. The NWS primarily tracks flood crests for major rivers only, so flooding along the county's smaller streams and depression area flooding are not forecasted.

Although Lake County has a system of stream and rain gages jointly operated by the United States Geological Survey (USGS) and the Lake County Stormwater Management Commission (SMC), it does not have an established local forecasting model to supplement the information provided by the NWS at the four warning sites on the Des Plaines and Fox Rivers.

Real Time Telemetry Stream Gages

- ✓ Buffalo Creek near Wheeling
- ✓ Channel Lake near Antioch
- ✓ Des Plaines River at Russell
- ✓ Des Plaines River near Des Plaines
- ✓ Des Plaines River near Gurnee
- ✓ Drainage Ditch at Libertyville
- ✓ Fox Lake near Lake Villa
- ✓ Fox River at Algonquin
- ✓ Fox River at Johnsbury
- ✓ Fox River at Wilmot, WI
- ✓ Fox River near McHenry (Headwater)
- ✓ Fox River near McHenry (Tailwater)
- ✓ Mill Creek at Old Mill Creek
- ✓ Nippersink Lake at Fox Lake
- ✓ North Branch Chicago River at Deerfield
- ✓ Skokie River near Highland Park
- ✓ Squaw Creek at Round Lake
- ✓ West Fork North Branch Chicago River at Northbrook

There are rain and stream gages equipped with telemetry allowing telephone access to real-time data. While there is no flood crest predictions for these sites, the County EMA office and SMC have ready access to this gage information and can track water levels before and during a flood.

Considered Improvements

- Improve ease of access to rain and stream gage information to increase municipal, township and county use.
- Provide training for county, township and municipal emergency managers on interpretation and use of gage information.

Flood warning

Once the flood threat recognition system tells the emergency manager that a flood is coming, the next step is to notify staff in other agencies, the public and critical facilities that a flood is imminent. The earlier and the more accurate the warning, the greater the number of people who can implement protection measures. Multiple or redundant systems are most effective: if people do not hear one warning, they may still get the message from another part of the system.

Most flood warning programs have two levels of notification:

- *A flood watch:* conditions are right for flooding.
- *A flood warning:* a flood has started or is expected to occur in the community.

The Lake County Administrator is the officially designated Public Information Officer during an emergency. The Emergency Services Coordinator (ESC) assists him. The Lake County Sheriff's Office is responsible for operating a dispatch center. The dispatch center communicates with all county departments, and is responsible for disseminating warning information to the public and notifying key response personnel during an emergency. Communications are maintained with county and local agencies for the receipt of situation reports and monitoring the effects of, and response to, the emergency.

Emergency information is also disseminated through the local media. The primary source of emergency public notification for Lake County is through radio stations. WMAQ (AM-670) has been designated as the primary Emergency Broadcast Station for Lake County. WKRS (AM-1220) and WXLG (FM-102.3) in Waukegan are backup Emergency Broadcast Stations. Other Lake County area radio and television stations will provide the public with an alert signal and message to tune to WMAQ radio. Chicago radio and television stations also broadcast some emergency information.

The County has its own radio network for emergencies called the Radio Amateur Civil Emergency Services (RACES) that maintains a school warning system and can also tie into hospitals and nursing homes in an emergency. Lake County schools, businesses and a number of County agencies have installed 156.210 Mhz warning radio receivers for early notification.

If the situation warrants, the County Board Chairman, or his alternate, notify the ESC to activate the Emergency Alert System. The public warning system for natural and technological disasters includes the Outdoor Warning Siren Alert Tone. Outdoor warning sirens have been installed in a number of locations throughout the county. (Areas in the county where the outdoor warning sirens are insufficient have been identified by Emergency Services.)

A number of the designated sirens can be activated manually at the siren site during a disaster. Community EMA coordinators, fire chiefs, mayors and police chiefs are authorized to activate these systems. The siren is a signal to the public to turn on televisions or radios to an emergency broadcast station where emergency public information and instructions on the type of protective actions that need to be taken are broadcast.

There is also a Lake County Public Emergency Notification System that uses tone activated police radios. In addition to the Emergency Alert System and radio system, the ESC also passes flood warning information to affected communities and townships by telephone. The fire and police departments provide mobile sirens and public address systems, and door-

to-door notifications when necessary. The ESC is responsible for notifying the IEMA Communications Center of all disaster warnings.

Once a local emergency is declared, a Media Briefing Room is set up at the emergency operations center. Regular press briefings and potential field tours will be scheduled by the PIO. The PIO is responsible for disseminating factual information to the media and community residents. At the same time, a rumor control team monitors local media stations in an attempt to discover and suppress non-factual information. A series of telephone numbers with current information will also be available to the public.

The Illinois State Police and Illinois Emergency Management Agency forward alert messages through the Sheriff's office or through the County EMA Coordinator (ESC). County level information is shared with these agencies, and when possible, the PIO coordinates press releases.

Considered Improvements

- Set up local automated fax notice warning system for flood risk areas that includes all applicable municipalities, townships, county agencies and critical facilities.

Flood response

Once a flood threat is recognized, the first priority is to alert others through the flood warning system. The second priority is to respond with actions that can prevent or reduce damage or injury. The table on the next page identifies typical flood response assignments in Lake County.

When resources at the local level and state level are insufficient to deal with a large scale flood emergency, assistance is available from the federal government. Determinations for when the severity of the flood requires state and federal assistance is reflected by state and federal disaster declarations for a county.

A major disaster declaration triggers federal assistance to alleviate flood damage, hardships or suffering. The bulk of federal assistance comes through FEMA, the US Army Corps of Engineers (Corps) and the Small Business Administration (SBA).

FEMA coordinates disaster assistance to local governments and provides mitigation funds to elevate or remove buildings from flood hazard areas during flood recovery. The Corps can assist communities in flood emergencies by providing materials equipment and personnel for flood fighting, and the SBA offers disaster loans at low interest rates to both families and businesses.

Flood Response Assignments

Activating the emergency operations center	⇒ Lake County Emergency Services (EMA) Coordinator - coordinates emergency response of all county agencies.
Sandbagging certain areas	⇒ EMA office provides bags and has Sandbagger machine, public works or township road department coordinate operations with citizen volunteers
Maintaining highway system: storm sewers, streets, bridges	⇒ Lake County Department of Transportation (signs/markings, debris removal, storm sewer and drainage structure repair)
Closing streets or bridges	⇒ police/sheriff's department coordinated with appropriate road authority
Protecting water supplies and wastewater treatment facilities	⇒ Department of Public Works
Shutting off power to threatened areas	⇒ utility companies
Releasing children from school	⇒ school districts
Ordering an evacuation	⇒ Lake County Board Chairman, Sheriff's Office, Mayor, local police
Opening evacuation shelters - providing welfare services	⇒ EOC, Townships, Red Cross, Salvation Army, Lake County Chaplains, Catholic Charities
Guarding sandbag walls, evacuated areas and other protection measures	⇒ local police/Sheriff

A flood response plan is the best way to ensure that all bases are covered and that the response activities are appropriate for the expected flood threat. The *Lake County Emergency Operations and Preparedness Plan (Emergency Plan)* serves as the flood response plan for Lake County.

Various county departments and agencies are responsible for maintaining their own emergency management procedures and response equipment. The *Emergency Plan* identifies and describes the activities of county departments and agencies responsible for flood response.

The *Emergency Plan* is also intended to increase awareness and improve coordination of county emergency preparedness and response activities. It is organized into chapters and annexes based on service or need area such as: medical, public health, highways, public works, warning, evacuation, damage assessment etc.. Each area of need includes a very useful response

operations checklist that details steps and responsibilities during an emergency event.

The *Emergency Plan* includes a general description of county procedures and emergency responsibilities for all potential natural and technological disasters. It does not include a response program geared specifically to flooding, therefore it does not contain detailed guidance on flood fighting or recovery.

Flood Response Plan Needs

- ✓ Monitor flood levels
- ✓ Alternative transportation routes for main roads or bridges closed by flooding
- ✓ Provide guidance to building owners for shutting off gas and electric when flooded
- ✓ System to order/supervise the removal of valuable property before the flood arrives
- ✓ System to implement alternate water use rules if water supply is compromised
- ✓ Monitoring of drainage swales, bridges & culverts to insure they are not clogged with debris
- ✓ Monitoring of reservoir and detention basin inlets, outlets and spillways to insure they are functioning correctly
- ✓ System for monitoring lake levels
- ✓ Special hazards such as downed power lines
- ✓ A systematic and consistent method of reporting flood damage to LCEMA

The *Emergency Plan* also does not address the municipal role in flood response. But, LCEMA does play a role in supporting and coordinating municipal flood response. Each community in Lake County is required to designate a township or municipal EMA coordinator. The LCEMA coordinator sponsors monthly meetings and training workshops for these local coordinators to better integrate services in response to floods and other emergencies.

As it is currently constructed, the *Emergency Plan* is based on existing resources and operational equipment and serves to report on existing county emergency activities. It does not include a thorough assessment of the effectiveness of county response programs, nor does it include recommendations for better coordination or improvements to current procedures for future plans.

The *Emergency Plan* is kept current through updates every other year, where changes to current procedures are considered, and additions can be made to the plan.. This update process affords an opportunity to potentially add a "flood annex" to

the plan that may include more detailed flood response activities. Examples of flood response needs that might be considered in a specific flood annex to the plan are listed in the box on the previous page.

Considered Improvements

- Incorporate more proactive response activities in emergency plans. (i.e. identify and closely monitor known problem constrictions in drainage system; system of monitoring lake levels by lake associations for lakes with associated flood problem areas; guidance to property owners on when and how to turn off utilities during flood)

- Conduct training program for lake and homeowner associations in flood response.
- Install alarm systems on lift stations.
- Add a "Flood Annex" to the *Lake County Emergency Operations & Preparedness Plan*.
- Standardize and improve system of flood damage reporting by the county, townships and municipalities in computerized database format.

Critical facilities

Protecting critical facilities during a flood is a vital part of any emergency service effort. If a critical facility is flooded, workers and resources may be unnecessarily drawn away from protecting the rest of the community. If such a facility is prepared, it will be better able to support the community's flood response efforts.

Most critical facilities have full-time professional managers or staff who are responsible for the facility during a disaster. These people often have their own emergency response plans. State law requires hospitals, nursing homes, and other public health facilities to develop such plans.

The Lake County EMA Coordinator maintains lists of critical facilities in the County, but the information is not compiled for all critical facilities. It is the individual community or township's responsibility to plan for critical facility response within their jurisdiction.

Considered Improvements

- Each community and the county should, in conjunction with other appropriate jurisdictional authorities (township, county, state, tollway authority), map all critical transportation routes and planned detours.
- Identify and map all critical facilities located in flood hazard areas.

Critical Facilities

(FEMA definition)

- ✓ Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood.
- ✓ Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before during and after a flood.
- ✓ Public and private utilities that are vital to maintaining or restoring normal services to flood impacted areas before during and after a flood.
- ✓ Structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic and/or water reactive materials.

Critical Facilities in Lake County

(LCEMA data)

Type of Facility	Number
Emergency operations centers	48
Schools	
Police stations	36
Fire stations	35
Hospitals	
Nursing homes	
Water treatment plants	30
Wastewater treatment facilities	17
Evacuation routes	
Hazardous materials storage	450

Health and safety maintenance

Preventing dangers to health and safety is critical after a flood. The flood recovery plan should identify appropriate measures to take. The plan also should identify which agencies will be responsible for carrying out these measures. Normally, they are the police, sheriff, or public health authorities.

Appropriate measures for protecting public health and safety include:

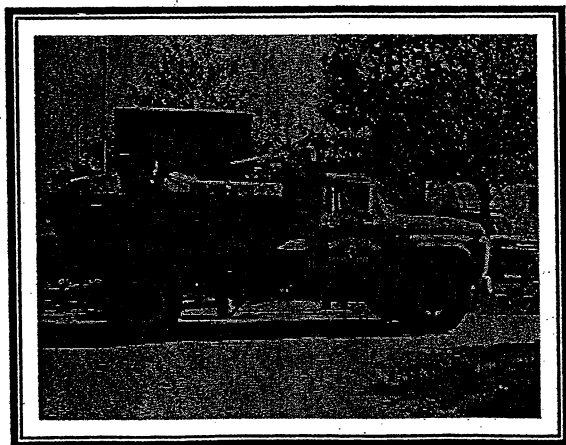
- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Inspection of shelter food preparation and distribution facilities
- Inspection of food facilities prior to re-opening after flooding
- Insure adequate sanitary facilities for sheltered population
- Providing appropriate inoculations
- Clearing streets
- Cleaning up debris and garbage

The *Lake County Emergency Operations and Preparedness Plan* covers responsibilities for most of these measures. Within Lake County, the police, sheriff or reserves are responsible for protecting evacuated areas. Depending on road authority, the Tollway Authority, Illinois Department of Transportation (395 miles), Lake County Department of Transportation (270 miles) or the Township highway departments (530 miles) are responsible for clearing roads. A response and recovery checklist are included in the Highways Appendix of the *Plan*.

The Lake County Health Department, in cooperation with the Public Works Department and the appropriate water treatment agencies (including JAWA), test the water supply throughout the emergency to insure it has not been contaminated. The County Health Department is also responsible for inspection of food services, runs necessary inoculation programs, and will check private wells and septic systems that have been flooded

within 14 days of request. The Public Health Appendix of the *Plan* includes a response and recovery checklist that covers all of these responsibilities excluding the checking of private wells and septic systems.

The Lake County Red Cross is responsible for the operation of shelters based on a *County Shelter Plan* developed by the County Department of Emergency Services. These agencies work cooperatively to select shelters and train staff. The



Salvation Army, church groups and other volunteer organizations may provide additional assistance.

While the *Lake County Emergency Operations and Preparedness Plan* is silent on the subject of flood clean up responsibilities, the EMA office supports community efforts at cleanup and debris removal from curbside (citizens are required to get the trash and debris to the curb).

Considered Improvements

- Identify and map all hazardous storage sites located in flood hazard areas.

Flood Control

Structural flood control measures are used to prevent floodwaters from reaching properties, thus preventing damage. These measures generally involve construction of man-made structures to control water flows.

Because of their size and cost, structural projects typically are implemented with the help of state or federal flood control agencies such as the Illinois Department of Natural Resources Office of Water Resources, the US Army Corps of Engineers, and the USDA Natural Resources Conservation Service.

- | Flood Control Projects | |
|------------------------|-------------------------------|
| ✓ | Reservoirs/regional detention |
| ✓ | Management of dams |
| ✓ | Levees and floodwall |
| ✓ | Conveyance improvements |
| ✓ | Improving crossings/roadways |
| ✓ | Streambank stabilization |
| ✓ | Drainage and storm sewer |

Structural projects offer advantages not provided by other measures, but as shown below, they also have major shortcomings. The appropriateness of using structural flood control depends on individual project area circumstances.

Since structural flood control is generally the most expensive type of mitigation measure in terms of installation costs, maintenance requirements and environmental impacts, a thorough alternative assessment should be conducted before choosing a structural flood control measure. In some circumstances smaller structural flood control measures may be included in a package of several recommended measures for a project area where non-structural measures would not be practical or effective.

Because larger structural flood control projects have regional or watershed-wide implications, they are often planned at a regional level by the state and federal agencies that provide the majority of project funding. Nonetheless, communities should participate in and coordinate with regional flood control studies to insure they are practical, effective and have community acceptance.

Pros and Cons of Structural Flood Control Projects

Advantages

May provide the greatest amount of protection for land area used.

Because of land limitations, may be the only practical solution in some circumstances.

Can incorporate other benefits into structural project design such as water supply and recreational uses.

Regional detention may be more cost-efficient and effective than requiring numerous small detention basins.

Disadvantages

They disturb the land and disrupt natural water flows, often destroying wildlife habitat.

They require regular maintenance, which if neglected, can have disastrous consequences.

They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.

They can create a false sense of security as people protected by a project often believe that no flood can ever reach them.

Although it may be unintended, in many circumstances they promote more intensive land use and development in the floodplain.

Flood control studies have been done by federal and state agencies on the North Branch of the Chicago, Des Plaines and Fox Rivers. Some recommendations from these studies for reservoirs and levees have been constructed, others have not.

Reservoirs/Regional Detention

Reservoirs and regional detention control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that is equal to or less than the capacity of the downstream channel. Reservoirs that maintain a water level may be used as a water supply and/or provide water-based recreational benefits. Wet or

dry detention basins can also serve multiple uses by doubling as parks or providing other open space uses.



Regional detention basins are more common in Northeastern Illinois than in-stream reservoirs

The amount of land needed, coupled with the expense of construction, management and maintenance limit the use of reservoirs. Reservoirs may fail to prevent floods that exceed their design levels, and may also eliminate the natural and beneficial functions of the floodplain.

Impoundments impact water quality as they are known to affect temperature, dissolved oxygen and nitrogen, and nutrients. In addition, sediment deposition may occur in a reservoir and over a period of years reduce the stormwater storage capacity.

Three flood control reservoirs have been constructed in Lake County on the North Branch of the Chicago River. Following study recommendations made by the Soil Conservation Service (1974) and the Corps (1988), the Duffy Lane Reservoir was constructed in 1990, and the Atkinson Road and Deerfield Reservoirs were completed in 1992.

Flood Control Reservoirs			
North Branch Chicago River			
Name	Stream	Year Built	Cost
Atkinson Road	Middle Fork	1992	\$5,557,000
Duffy Lane	West Fork	1990	7,980,000
Deerfield	West Fork	1992	6,767,000

While the reservoirs have been successful in reducing downstream impacts, some design problems resulted in backwater flooding upstream of the Duffy Lane and Deerfield Reservoirs in 1997. Based on a restudy funded by Deerfield and completed by the Corps in 1997, the Corps is changing several design features to improve water flow into and out of the reservoirs to remedy these unforeseen problems.

Considered Improvements

- County should develop a system for coordinating and funding regional structural flood control projects where they are appropriate in the mitigation mix.
- Locate areas that would be good for regional detention sites.
- County should establish standards (in WDO?) for design and construction of regional detention facilities to meet multi-objective criteria.

Management of Existing Dams

The Department of Natural Resources Office of Water Resources (IDNR-OWR) runs a dam safety program that requires dam permits and operations and maintenance plans. The strictness of the permit requirements and plans is dependent on several factors including the level of hazard caused by dam failure, dam height and impoundment capacity.

The primary determinant is dam hazard. Dams are rated as being either a high, intermediate, or low hazard depending on the damage risk for surrounding and downstream people and properties. IDNR-OWR permit and plan approvals require that a qualified engineer inspect dams. Generally, dams for in-ground stormwater detention basins do not require a permit.

In Lake County dams are largely managed and controlled by a municipality, lake or homeowners association, drainage district or private property owner. The Lake County established inspection program or operations and maintenance requirement. The Lake County Watershed Development Ordinance (WDO) requires that the appropriate IDNR-OWR permit (or letter indicating that no permit is required) be received for all projects requiring a dam prior to the issuance of a WDO permit.

Considered Improvements

- The condition and hazard potential of existing dams in the County should be inventoried.

Levees and floodwalls

Probably the best known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

Levees placed along the river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties upstream or downstream. To reduce environmental impacts and provide multiple use benefits a setback levee (set back from the floodway) is the best project design.

The area inside a setback levee can provide open space for recreational purposes and provide access sites to the river or stream. Key considerations when evaluating use of a levee include provision of compensatory storage and internal drainage. Levee projects should compensate for the floodwater storage that will be displaced by the levee, and the floodplain behind the levee, that is cut off from the river or stream. Levee plans should also include provisions for adequate internal drainage of surface flows from the area inside the levee.

Levees have limitations. They are expensive to construct and can require considerable land space and maintenance. In some cases it may be necessary to include pumping operations for internal drainage. Levees also act as barriers to river access, block views, and disrupt local drainage patterns.

Another serious concern with levees is that they frequently offer a false sense of security. In some cases land use behind a levee can change to high intensity, high-value occupation under the false assumption that all future floods will be controlled by the levee. While levees may reduce flood damages for smaller more frequent rain events, they may also over-

top or breach in extreme flood events and subsequently create more flood damage than would have occurred without the levee.

Floodwalls perform like levees except they are vertical-sided structures that require less surface area for construction. Floodwalls are constructed of reinforced concrete, which makes the expense of installation cost prohibitive in many circumstances. Floodwalls also degrade adjacent habitat and can displace erosive energy to unprotected areas of shoreline downstream.

Like other structural flood control projects, levees can be expensive and require a long study period before they are constructed. Lake County provides an example with the North Libertyville Estates levee.

North Libertyville Estates is a subdivision of approximately 140 homes constructed in the 1950s (prior to floodplain regulation) in the floodplain of a bend in the Des Plaines River. Serious flooding of the area occurred in 1960 and 1962 that prompted a local call for flood control.

After an attempt to get state assistance failed, a flood control study was begun by the Corps in 1984. Nine significant flood events damaged the subdivision in the 37 year interim prior to project construction in 1997.

Repeated flooding caused damage to homes, loss of access due to street flooding, and septic system failure. Several homeowners elevated their homes during this period successfully preventing flood damage, but septic failure and loss of access were still significant problems.



North Libertyville Estates has a levee and floodwall that protects the area from the Des Plaines River.

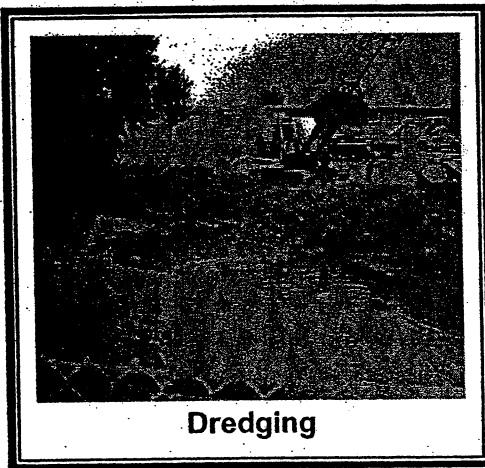
Timeline: North Libertyville Estates Levee

- 1953 North Libertyville Estates subdivision approved for construction
- 1960 First major flooding of subdivision
- 1969 Failed attempt to have levee constructed as State project.
- 1984 Libertyville Township requests assistance
- 1985 Initial appraisal by Corps prompts reconnaissance investigation
- 1989 Reconnaissance report indicates levee is economically justified ⇒ feasibility phase of study
- 1994 Detailed Project Report completed.
- 1995 Federal funds appropriated
- 1996 Corps and Lake County sign project cooperation agreement.
- 1997 Construction begins on \$2.5 million sanitary sewer and water main installation and \$2.2 million levee project.
- Project completed

The levee projected constructed in the fall of 1997 also required construction of a canal bypass and an extensive pumping system. Based on recent river hydrologic and hydraulic models, the levee should protect North Libertyville residents for up to a 40 year flood event.

Levee systems were also considered in the Corps' Feasibility Study for the Des Plaines River for the Village of Gurnee and Pekara Subdivision. Further calculation of the costs vs. benefits of these levees revealed that they would not be cost-effective, so they were dropped from the plan.

Conveyance improvements

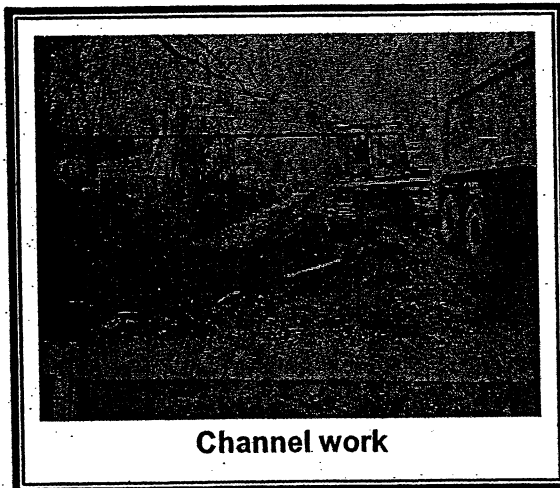


Dredging

By improving channel conveyance, more water is carried away at a faster rate. Improvements generally include making a channel wider, deeper, smoother or straighter. Some smaller channels in urban areas have been lined with concrete or put in underground pipes.

Dredging is one form of conveyance improvement. It is usually cost prohibitive due to disposal needs for dredged materials. Unless instream and/or tributary erosion are corrected upstream, the dredged areas usually fill back in within a few years, and the process and expense have to be repeated.

Straightening, deepening and/or widening a stream or river channel, commonly referred to as "channelization" has traditionally been the common remedy for local drainage or flooding problems. Channelized rivers and streams drain water faster from the area adjacent and upstream of the channel, but can create or worsen flooding problems downstream as larger volumes of water are transported at a faster rate.



Channel work

Channelized waterways tend to be unstable and experience more streambank erosion. The need for periodic reconstruction and silt removal becomes cyclic in these circumstances making stream/channel maintenance very expensive.

Where channel modification is the only practical flood control solution, it should be performed in an environmentally sensitive manner. Mitigation of natural habitat and water quality functions should be incorporated into the project. Properly sloped and planted channel banks are more aesthetically and environmentally appealing, and can prove cheaper to maintain than concrete ditches.

Numerous waterways in Lake County have been improved for conveyance purposes. As an example, all three of the North Branch tributaries were converted from meandering shallow streams and wetlands to straight drainage channels earlier this century. Changing the hydraulics of water transport with channelization has permanently changed the hydrology of the North Branch watershed.

A greater volume of runoff drains at a faster rate following a rain event, which has resulted in a very flashy hydrology. During rain events runoff from the land gets to the channel quickly and the stream rises very fast. Likewise, during dry periods the water level in the channel is lower than it should be, which creates water quality problems and degrades habitat.

The rapid rise and fall of water levels in the channels results in overbank flooding and causes severe streambed and streambank erosion in some areas. Sediment accumulation from upstream erosion is also significant in many areas of the channel where the water slows down during low flows and the sediment is dropped out. Sedimentation reduces the channel capacity in these areas and degrades aquatic habitat.

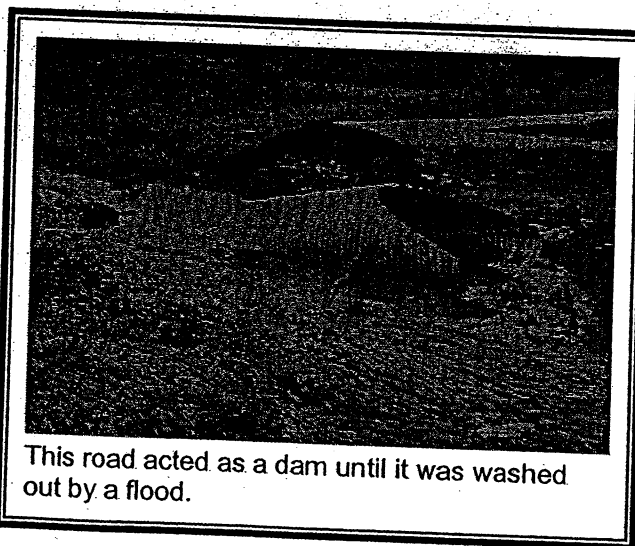
The North Branch of the Chicago River: Skokie, Middle Fork and West Fork tributaries, exemplify some of the local advantages, and off-site, long-term disadvantages, of channel modification. The big advantage of conveyance improvement was that it has made more land available first for agriculture, and then, suburban development. The long-term costs are on-going and include costs associated with the continual need for channel stabilization and maintenance, and the costs of remedying the resulting downstream flood damages.

Considered Improvements

- Maintenance timing and practices for channelized rivers and streams should be included in county adopted best management practice maintenance standards.

Improving crossings and roadways

In some cases buildings may be elevated above floodwaters but access to the building is lost when floodwaters overtop local roadways, driveways, and culverts or ditches. Depending on the recurrence interval between floods, the availability of alternative access, and the level of need for access, it may be economically justifiable to elevate some roadways and improve crossing points.



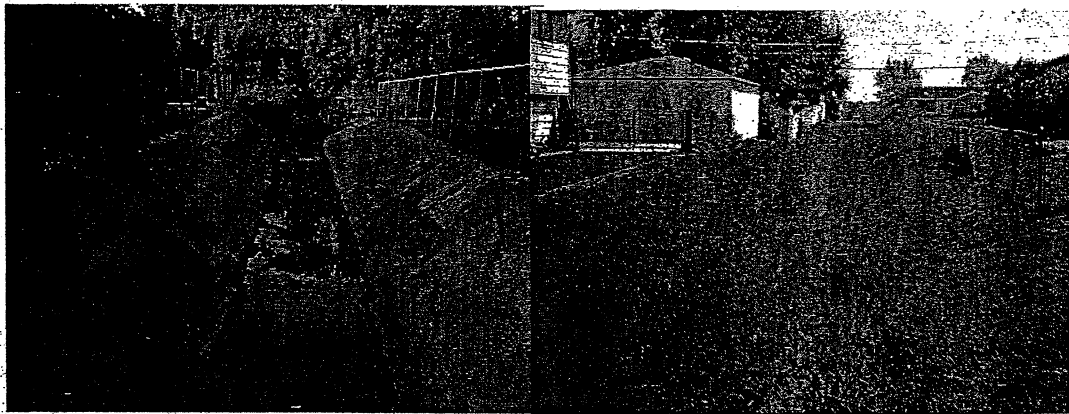
This road acted as a dam until it was washed out by a flood.

For example, if there is sufficient downstream channel capacity, a too small culvert that is serving as a constrictor creating backwater and causing localized flooding may be replaced with a larger culvert to eliminate flooding at the waterway crossing point. The potential for worsening adjacent or downstream flooding needs to be considered before implementing any crossing or roadway drainage improvements.

Drainage and storm sewer improvements

Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer improvements usually are designed to carry the runoff from smaller, more frequent storms. Storm sewer improvements include installing new sewers, enlarging small pipes, and preventing back flows.

Because drainage ditches and storm sewers convey water faster to other locations, improvements are only recommended for small local problems where the receiving stream or river has sufficient capacity to handle the additional volume and flow of water. To reduce the cumulative downstream flood impacts of numerous small drainage projects, additional detention or run-off reduction practices should be provided in conjunction with the drainage system improvements.



Drainage improvements do not have to be concrete channels. They can include measures to improve infiltration and water quality.

A combination of restored wetland detention, vegetated swales, infiltration trenches and other best management practices that increase infiltration (reducing runoff), and improve water quality can be implemented in conjunction with stormwater system improvements.

In the past many of the county and municipal flood mitigation projects have included localized drainage system improvements that have been largely funded with federal Community Development Block Grants and state and county funded transportation improvements.

Considered Improvements

- Require that all storm sewer improvements that result in increased drainage capacity be reviewed by SMC to address the problem of cumulative impacts on receiving waters.
- Strengthen training requirements for community WDO enforcement officers and professional engineers to improve consistency in review and application of WDO standards.

Public Information

Individual property owners usually implement property protection measures, therefore, a community mitigation program should include measures to encourage and assist owners in protecting their property from flood damage. Public information activities advise property owners, and potential property owners, about flood hazards and how to protect lives and property from the hazards.

Public Information Measures	
✓	Map information
✓	Library resources
✓	Outreach projects
✓	Technical assistance

In addition to raising awareness about the hazards of flooding, public information activities also educate community residents and businesses about the beneficial functions local floodplains provide. These activities are usually implemented by a public information office, but can also be the basis for developing a cooperative program with several different local agencies or departments.

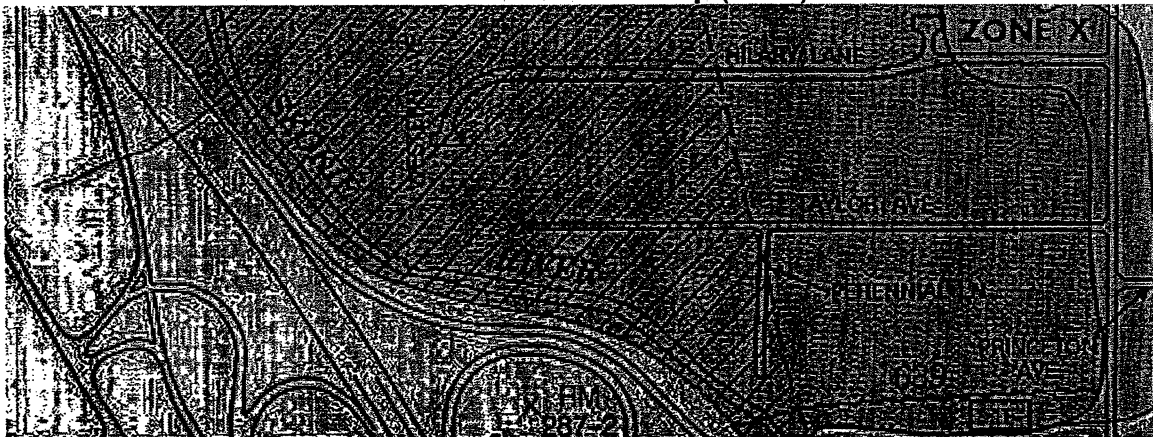
A community has passive and active ways to inform residents about flood hazards and damage mitigation. Passive ways to provide information include providing reference materials and map information in the public library, at government agency offices and on a web page. Active approaches include outreach projects and providing technical assistance. Four measures for a public outreach program are considered in this plan.

Map information

A system of providing map information to the public can offer many benefits. Property owners who are aware of the potential for flooding can take steps to reduce their exposure to flood damage. Real estate agents,

Special permits, building restrictions and flood insurance are required for floodprone properties. Map information will help developers and builders know what areas to avoid, and house hunters and real estate agents can find out whether a property is floodprone and if flood insurance is required.

Flood Insurance Rate Map (FIRM)



FIRMs are available to the public at all Lake County municipalities participating in the flood insurance program, and at the County Building and Zoning Department and Stormwater Management Commission (SMC). A guide to reading and interpreting these maps was produced and is distributed by SMC.

SMC has developed Lake County Flood Hazard Areas (Flood Hazard) maps in conjunction with this planning process. These were distributed to every community in 1998. In addition to the FIRMs and Flood Hazard maps, SMC also has the Lake County Wetlands Inventory, topographic maps and the Hydrologic Atlas available to the public.

Library resources

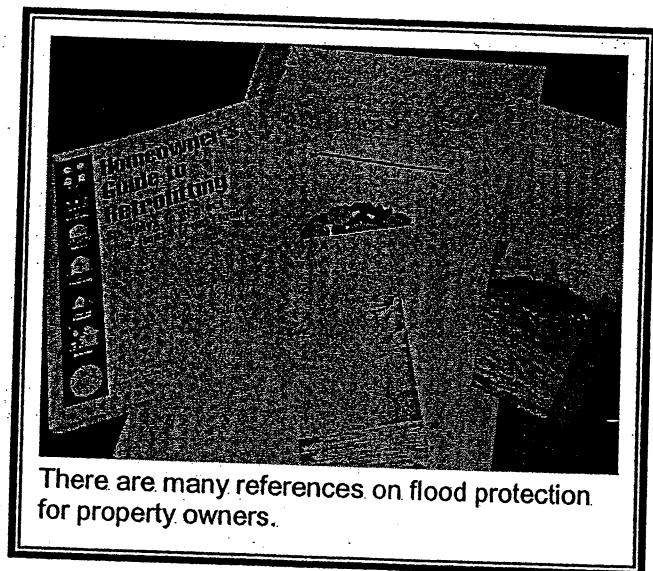
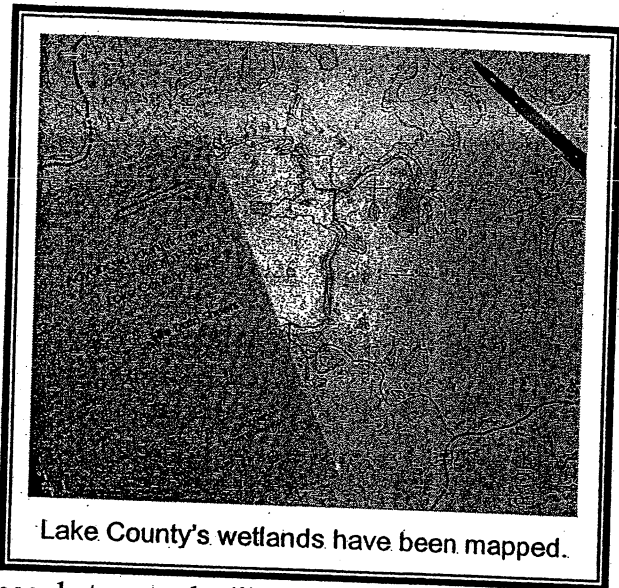
Community libraries are an obvious place for residents to seek information about flooding and flood protection. Maintaining and updating library resources with this information is an effective public information strategy, since most people turn to the library when they want to research a topic.

In addition to maintaining a resource file, libraries also frequently sponsor their own public information campaigns that might include displays, lectures and newsletter articles. Arranging one of these types of activities with the library can support and augment county or municipal public information campaigns on flooding.

In Lake County, information on flood awareness and response is currently available at the Stormwater Management Commission (SMC), the Lake County Emergency Management Agency (LCEMA), other Lake County departments and the American Red Cross office in Mundelein.

SMC has developed and distributes a number of brochures to other agencies and the public that address flood mitigation and response, and also serves as a clearinghouse for flood information available from the state and federal government and other agencies. Examples of SMC publications include:

- Guides for homeowners on riparian area management;
- A "who to call" list for drainage and flooding problems; and
- A brochure describing how to use the Digital Flood Insurance Rate Maps to identify flood risk.



SMC also maintains flood hazard information on its homepage through the Lake County website. The American Red Cross, the Federal Emergency Management Agency, the Illinois Department of Natural Resources Office of Water Resources also have print materials available in their office libraries.

Outreach projects

In addition to supplying information in a passive manner through library resources, a community may want to engage in several more proactive approaches directed to those people at greatest risk. Proactive approaches reach out to people and give them information, even when they don't ask for it. Outreach projects are designed to encourage people to seek out more information on flood protection. They may include:

- Mailing notices to floodprone property owners to introduce the idea of property protection;
- Holding workshops, "open houses" or other special events;
- Distribution of "how to" brochures, videos or handbooks to property owners associations, (or to individuals upon request);
- Presentations at meetings of neighborhood groups;
- Providing programs and information at public venues such as malls or fairs; and
- Media blitzes, including newspaper articles, and radio and television news releases and interview shows.

To be most effective, outreach projects should include information on property protection measures that homeowners can apply, and be locally designed and tailored to meet local conditions.

The County sponsored its first official "Flood Awareness Week" in 1997, and has held one each year since then. SMC organized weeklong activities that were co-sponsored by various County departments and agencies involved in flood hazard awareness and response. A day-long workshop was held for planners, realtors and insurance agents. Other events included an evening program for the general public that included several segments including an overview of the County's flood hazard; an introduction of all of the local players in flood response, flood protection and mitigation; and "where to go" or "who to call" for help.

Technical Assistance

In one-on-one sessions with property owners, community officials such as code enforcement staff or building inspectors can provide advice and information on identifying flood hazards at the site, correcting local drainage problems, floodproofing, dealing with contractors, and funding. More intensive assistance for highly flood prone properties may include conducting a "flood audit" that includes a written report covering remedial measures.



Several county agencies advise residents on flood risk and flood protection. The SMC provides advice and technical assistance to property owners associations, municipal governments and other local government units for areas that experience flooding on a watershed or regional scale. The Lake County Department of Building and Zoning offers technical assistance to property owners in unincorporated Lake County that experience relatively minor drainage and flooding problems.

Municipalities are responsible for providing this assistance within their jurisdictions, although not all have a system to do so, leaving some municipal residents without help. The appropriate municipal contact is generally the public works department.

The Lake County Health Department provides technical guidance related to septic system failure and well contamination. Formal "flood audits" are currently not provided as a county service.

Because flood events occur on an unpredicted and often infrequent basis, a good public information program is necessary for a successful flood mitigation program. When flood mitigation measures involve multiple partners or property owners, the acceptance of a flood mitigation proposal may rely upon an educated partnership and public. A public information program is also necessary to make private property owners aware of the options available to protect themselves from future flood damage, and to convince them that flood mitigation is a good expenditure of their funds.

Considered Improvements

- Build a county-wide partnership for coordinated delivery of public information materials and activities.

- Continue "Flood Awareness Week" and expand with more activities targeting the general public.
 - Identify all structures located in the floodplain, set up a database by address and notify all property owners of their potential flood risk.
 - Develop and implement a system to coordinate the distribution of flood mitigation and response guidance materials for pre-flood outreach to at risk property owners.
 - Plan and conduct an open house on property protection measures.
 - Build a flood mitigation display booth on property protection measures for use at home shows and the county fair.
 - Develop a partnership to plan and conduct flood mitigation programs that target communities and property owners at risk.
 - Increase outreach to community plan departments and commissions to strengthen local understanding and review of development proposals and their compliance with WDO standards.
-

Chapter 6. Goals

Goal 1: Protect public health and safety.	6-1
Goal 2: Reduce property damage.	6-1
Goal 3: Maintain the drainage system.	6-2
Goal 4: Enhance the environmental and aesthetic quality of the floodplain.	6-2
Goal 5: Establish a coordinating system.	6-2

The goals for the Flood Hazard Mitigation Plan set the overall direction of the County's flood mitigation efforts. They are used to determine the most appropriate and priority action items in the next chapter.

Five goals were developed. These were based on public and peer agency input gathered during several steps in the planning process, including:

- Issues, concerns and recommendations raised at three public workshops held in 1996;
- Responses received on survey forms used during the problem identification process (1995-1996); and
- Personal interviews with municipalities, peer agencies and county board members.

Goal 1: Protect public health and safety.

The most important goal of this program is to protect lives and health. People need to become aware of the flood hazard they face in their homes, workplaces, and on the roads. They need to know how to protect themselves and their families and they need to be encouraged to take protection measures.

Goal 2: Reduce property damage.

Flood damage results in heavy costs to Lake County residents, businesses and local governments. As noted in Chapter 2, some of these costs can be calculated based on actual replacement dollars for damaged buildings, others, such as time lost due to transportation snarls when roads or bridges are out, the loss of personal well-being, or the loss of irreplaceable possessions, are more difficult to quantify in dollar terms.

Reducing property damage involves both preventing flood damage from worsening as the county develops and remediation of existing flood problem areas.

Goal 3: Maintain the Drainage System.

Floodplains provide a number of benefits to Lake County residents and businesses, not least of which is storage and conveyance of floodwaters following storm events. The natural drainage system of floodplains, wetlands and other depressional areas must be maintained to minimize damage and public improvements to create a "synthetic" drainage system.

Goal 4: Enhance the environmental and aesthetic quality of the floodplain.

Because of their location adjacent to rivers, streams, and lakes, floodplains serve as a buffer to filter stormwater that runs off of adjacent developed uplands. In this way floodplains and wetlands improve the quality of water people drink, swim, boat and fish in.

In addition to improving water quality, floodplains provide great ecological value. Floodplains and bottomland forests provide some of the richest habitat for plants and animals. They also are significant as corridors, similar to trails or roadways for people, that connect habitat areas for plants and wildlife.

Economic benefits result from the ecological enhancement of floodplains. High quality floodplains can serve as scenic attractions for recreation and tourism diversifying and improving the local economy. Environmental and aesthetic enhancement of floodplains also provides vistas for some of the highest value homesites along adjacent uplands.

Goal 5: Establish a coordinating system.

To improve the county's efficiency and effectiveness in mitigating flood damage, mitigation measures should be prioritized and action responsibilities coordinated among county and municipal departments and agencies.

Some several mitigation actions will give the best return for flood mitigation dollars if coordinated at the county level. These include:

- Establishing an equitable system for prioritizing flood hazard areas for mitigation resources;
- Developing a standard method for collecting, reporting and sharing flood damage information; and
- Conducting public information campaigns.

Chapter 7. Partners in Flood Mitigation

Stormwater Management Commission.....	7-1
County Agencies.....	7-2
Local governments.....	7-6
State Agencies.....	7-8
Federal Agencies.....	7-9
Private Organizations.....	7-10
Flood Mitigation Task Force	7-11

Due to its all-encompassing nature, a *Flood Hazard Mitigation Plan* must involve many agencies, organizations, private businesses and property owners. These partners are vital to the success of the recommendations and action plan. This chapter reviews who they are and what their roles can be.

The next chapter assigns responsibilities to these partners, using the abbreviations listed in the box on the next page.

Stormwater Management Commission

The Lake County Stormwater Management Commission (SMC) is composed of 6 county board members and 6 municipal mayors or village presidents. It was formed in 1990 to address stormwater management issues on a watershed basis throughout the county.



STORMWATER MANAGEMENT COMMISSION

SMC performs both regulatory and advisory functions for the County of Lake and its 52 municipalities. SMC staff administer the countywide Watershed Development Ordinance through a permitting program, provide consultant services for stormwater best management practices to communities and citizens, develop watershed plans for the county's 26 subwatersheds, and coordinate multi-jurisdictional water management projects.

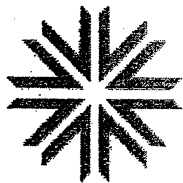
SMC has taken the lead role in formulating this *Flood Hazard Mitigation Plan*, and will also be responsible for implementing, evaluating and revising the plan as needed.

Lake County Partners in Flood Mitigation

Agency	Abbreviation
Stormwater Management Commission	SMC
LC Emergency Management Agency	LCEMA
Planning & Development Department	P&D
LC Department of Transportation	LCDOT
LC Health Department	LCHD
LC Department of Public Works	LCDPW
Forest Preserve District	FPD
9 Drainage Districts	DD
18 Townships	TWNSHP
52 Municipalities	MUNIS
Police Departments	Police
Fire Departments	Fire
Illinois Emergency Management Agency	IEMA
Illinois Department of Natural Resources	IDNR
Federal Emergency Management Agency	FEMA
US Army Corps of Engineers	Corps
American Red Cross	Red Cross
Other non-profit organizations	

County Agencies

Emergency Management Agency



The Lake County Emergency Management Agency (LCEMA) has primary responsibility for coordinating flood warning and response activities in Lake County. LCEMA plans for, and coordinates, emergency response for all natural and technological hazards. County department responsibilities for flood and other emergency warning and response activities are described in the Lake County Emergency Operations and Preparedness Plan, which is updated biannually.

In addition to planning and coordinating emergency response, LCEMA also assists in flood warning by tracking the weather and monitoring stream gages on the Des Plaines River. LCEMA operates the Emergency Operations Center, notifying local governments at risk, and distributing sandbags to municipalities and townships upon request during a flood event.

LCEMA also coordinates the dissemination of flood risk information to the general public through media broadcasts. Lake County has its own radio network for emergencies called the Radio Amateur Civil Emergency Services (RACES), which is housed in the same building as LCEMA. The RACES network maintains a school warning system and can also reach hospitals and nursing homes during an emergency.

If the flood is significant enough to warrant a state or federal disaster declaration, LCEMA collects flood damage information from communities to submit to the Illinois Emergency Management Agency, and coordinates response and recovery efforts with federal and state agencies providing assistance.

Planning & Development Department:

Lake County Planning and Development (P&D) Department has a significant role in flood prevention. P&D is responsible for formulating and administering county ordinances related to land use and development, which includes the county zoning ordinance.

P&D also reviews and makes recommendations to the Planning Committee for development proposals in the unincorporated areas of the county, and does long term land use planning. Currently P&D is developing a new Unified Development Ordinance for Lake County that will combine and improve the regulatory and planning provisions of several ordinances. Planning staff are also preparing an update of the comprehensive land use plan for Lake County.

The Building and Zoning (B&Z) division of P&D is certified by SMC to review and issue Watershed Development Ordinance permits for developments in unincorporated Lake County. With this authority, B&Z is responsible for stormwater management for approximately 45% of the county's land area.

B&Z also has inspectors who respond to requests for assistance in resolving drainage and localized flooding problems in unincorporated areas. B&Z, using a system of manual identification on plat maps, maintains a record of parcels that include floodplains and/or have known drainage problems.

Department of Transportation

Lake County Department of Transportation (LCDOT) fulfills both flood mitigation and flood emergency response roles. In their emergency response role, LCDOT responds to road flooding and drainage problems in their designated road right of way, and has a staff of 65 people available to help other departments or municipalities where needed.

LCDOT has a cooperative arrangement for notification and information with the Illinois Department of Transportation (IDOT) and the Illinois Tollway Authority. They notify each other in the case of road closures and traffic detours that affect other roadway jurisdictions. IDOT also notifies LCDOT before making long term road closures.

When a road floods, local law enforcement officials will close the road and contact the Emergency Operations Center (or Sheriff's Department) and notify them of the closure. The Emergency Operations Center (EOC) contacts the maintenance personnel at LCDOT, who determines whether the flooding condition will require an official road closure with a barricade.

If an official closure is necessary, the LCDOT traffic department develops a detour plan. The sign department makes up the appropriate closure and detour signage and marks the road according to state standards. This process generally takes a minimum of 3-4 hours. For road locations that are a chronic site of flooding, LCDOT is prepared to address the problem and can respond faster. After the flood event has passed, LCDOT assesses damage and determines what areas need to be addressed.

In addition to flood response, LCDOT also takes a proactive role in flood mitigation. They have a 5 year plan for road improvements that targets chronic flooding and drainage problems. Their objective is to minimize road closures. Another proactive approach is a maintenance schedule that keeps bridge and culvert areas known to collect debris cleaned out.

Health Department

The Lake County Health Department (LCHD) responds to health hazards during and following a flood event. Services provided by LCHD include monitoring drinking water supplies, which includes free analysis of water from wells covered by flood waters. LCHD monitors evacuation points during a flood and provides medical services when needed. Following a flood, LCHD inspects all food establishments in areas affected by flooding, and provides advice to homeowners to reduce hazards encountered during cleanup.

LCHD also monitors bathing beaches for fecal coliform, and will close a specific beach following a flood event if contamination occurs. LCHD may issue a countywide warning recommending no swimming for 24-48 hours following a flood event when by-passes or direct overflow discharge of sewage into lakes occurs.

LCHD monitors wastewater treatment plants on a monthly basis, which provides them with a base of information to target those treatment systems known to have capacity or infiltration and inflow problems. LCHD also provides consultation services to municipalities or residents in areas where sewer backup flooding is a problem and consults with property owners regarding remedies for septic failure.

Department of Public Works

The Lake County Public Works (LCPW) Department provides service for sanitary sewers in unincorporated Lake County. LCPW does not have a specific flood response plan for the County, but it is developing a maintenance plan (with the Army Corps of Engineers) for a new sanitary system installed in conjunction with a Corps' levee for North Libertyville Estates (1997-98).

Although the LCPW has no formal program or plan for flood response, they do have maintenance crews on call round the clock to address problems. When weather conditions indicate a potential flood problem, staffing levels are increased (usually in the spring).

LCPW has devices installed to monitor levels in lift stations. When sewer back-up problems occur, the maintenance division responds. Their notification of the problem is generally either from a phone call or an alarm on a lift station. LCPW wastewater treatment plants have capacity designed into the system to handle the increase in flows that follow a rain event. There are no combined storm sewer and sanitary systems in LCPW jurisdiction.

Forest Preserve District

The Lake County Forest Preserve District (LCFPD) has a significant role in flood prevention through acquisition and management of floodplain properties. LCFPD has acquired a considerable amount of the floodplain along the Des Plaines River and owns floodplain properties along the Middle Fork of the Chicago River and the Fox River Preserve.

One of LCFPD's five guiding requirements for land acquisition is to "provide flood control". The other requirements are to protect wildlife habitat, form trail and greenway corridors, preserve natural communities, and to add to existing Preserves. Unless a site is being considered specifically for flood reduction, flood control is not a high priority in most acquisition decisions, but rather is viewed as an added benefit.

In addition to ownership of floodplain, the LCFPD also owns three properties that have actively managed flood control reservoirs (Atkinson Road, Bannockburn and Buffalo Creek properties).

The Operations Department of the LCFPD is also active in flood prevention through their regular maintenance program for the Des Plaines River. LCFPD crews are regularly assigned to float the river adjacent to LCFPD properties and clear log jams and other debris blockages.

The Operations Department also responds to flood events in several ways. They respond to calls for mutual aid by other county agencies, which in-

cludes sandbagging support when needed. Operations staff also repair flood damage on LCFPD properties. Repair is usually centered on trails, and the marina and boat dock on the Fox River.

Local governments

Drainage Districts

There are 9 active drainage districts operating in Lake County. Each district is guided by three commissioners who contract for legal, engineering and construction services as needed. Commissioners for 8 of the 9 districts are appointed to a 2-year term by the county board chairman.

The districts have authority to maintain drainage conveyance in designated waterways within their district boundaries. They conduct drainage maintenance activities within a 50-foot right-of-way easement along each side of the stream (or ditch) channel.

The current level of drainage activity varies widely by district throughout the county. The degree of district activity is directly related to drainage needs as determined by adjacent flood damage and the amount of funding available. The districts are funded through property assessments for landowners located within the district boundaries. Generally funding for larger drainage projects exceeds ongoing maintenance resources, and requires an increase in property assessment or cost-share funding from other units of government.

Townships

Townships assist residents in flood fighting and recovery following flood events. The township's role in providing social services and financial assistance increases following a disaster. The township provides money for basic needs and clothing.

Townships are also responsible for responding to and repairing flood damage on township roads. Most townships coordinate flood fighting services such as sandbagging and provide assistance in evacuation and clean-up.

Municipalities

Municipalities are the first line of defense in flood emergency response and for flood prevention in the incorporated areas of the County. There are 50 cities and villages in Lake County that account for approximately 55% of county land area.

The local police are first responders during a flood event, closing flooded roads and bridges, re-routing traffic, assisting in evacuations and providing personal and property protection. Local police coordinate with municipal and township leaders, LCEMA and LCDOT as needed for flood response.

Local fire departments also respond with assistance for emergency evacuations. An important role for fire departments during flood events is response to flooding of hazardous waste sites when specialized hazardous materials cleanup is required. Each municipality is required to have a designated liaison with the County Emergency Services Coordinator (ESC) for purposes of planning and coordinating response to floods and other emergencies. The municipal liaisons, along with county staff and support agencies, are invited members of the Emergency Management Coordinating Council that meets monthly.

Municipal staff receive the first call for assistance made by their residents during an emergency. The CEO of the municipality (Village President or Mayor) has ultimate responsibility for emergency response within their jurisdiction.

The level of municipal disaster preparedness, and the capacity for community assistance, varies considerably among the municipalities throughout the county. Several municipalities, including Zion and Round Lake have very active liaisons who regularly participate in planning for, and responding to, emergencies.

Other communities, especially those with small staffs, have relatively low participation rates and response capabilities. When municipal resources are overwhelmed, the municipality calls on the county for mutual aid assistance.

Following a flood event, the Lake County Emergency Management Agency (LCEMA) relies on each community to record and report flood damages. Damage reports are then compiled by LCEMA and reported to Illinois Emergency Management Agency to help decide if a disaster declaration should be made.

Land use planning (and development) is under the jurisdiction of the municipality, which has the authority to regulate and acquire flood risk areas. Because of their land use planning authority, municipalities also determine the community's level of interest and activity in flood prevention.

Several areas of flood prevention a community may undertake include floodplain and wetland regulation, land acquisition and stormwater runoff reduction. Federal, state and county regulatory programs are considered the minimum standards upon which the community's program can be

built, but municipalities have the final say in determining the stringency of floodplain and wetland regulation within their jurisdictions.

Municipalities are also at the forefront in acquiring floodplains and wetlands for public ownership and incorporating them into the community's parks and recreation programs.

State Agencies

Illinois Emergency Management Agency



The Illinois Emergency Management Agency (IEMA) coordinates flood and other disaster planning, response and mitigation activities for the State of Illinois. A Regional Coordinator coordinates IEMA activities with the County and municipalities working through LCEMA.

IEMA provides training programs for local governments, reviews local plans, offers advice and assistance on emergency preparedness, provides operational support during an emergency and also administers a hazard mitigation grant program.

Illinois Dept. of Natural Resources, Office of Water Resources



The Illinois Department of Natural Resources Office of Water Resources (OWR) is the state's lead agency on structural flood control and flood damage reduction. Three divisions within the OWR provide assistance in local flood mitigation efforts.

The Division of Resource Management administers the floodplain management program. This program regulates and requires permits for channel and floodplain construction. In Lake County this regulatory authority has been delegated to SMC, although OWR concurrence is required for permits that affect changes to the base flood elevation or the delineated floodplain.

National Flood Insurance Program coordinators work with local governments by reviewing regulatory compliance and helping with mitigation and planning. The dam safety permit and inspection program is also a part of this Division.

The Division of Planning does initial surveys and makes recommendations for flood control or acquisition projects to local officials for local flood problem areas. If a project is warranted, the Division coordinates planning and funding and provides project design. The Planning Division can also contribute financial assistance on small projects of up to \$75,000.

The Division of Project Implementation provides advice and assistance on stream and channel maintenance. Resident Engineers in this Division oversee construction of projects.

Federal Agencies

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) is the lead Federal agency responsible for responding to floods and other disasters. Three offices in FEMA have significant roles in flood response and mitigation.



1. The Mitigation Division is responsible for coordinating community participation in the National Flood Insurance Program (NFIP) and the Community Rating System (CRS). This division helps communities draft and enforce local floodplain ordinances; coordinates flood insurance studies and provides floodplain boundary maps.

Two Divisional programs provide funding assistance for mitigation:

- The *Flood Mitigation Assistance Program* provides 75% cost-share grants for mitigation planning and projects implemented as a result of the plan.
 - The *Hazard Mitigation Grant Program* provides 75% cost-share funds for mitigation projects in a state following a nationally declared disaster.
2. The Response and Recovery Division responds when a flood or other disaster results in sufficient damage to result in a disaster declaration by the President. This division sets up a Disaster Service Center, an information hotline or both to handle applications for assistance. Assistance is provided for both private property and public building damage.
 3. The National Flood Insurance Program (NFIP) is administered by insurance companies but is overseen by FEMA. The NFIP is discussed in Chapter 5 under property protection and insurance.

US Army Corps of Engineers

The US Army Corps of Engineers (Corps) is the federal government's lead flood control and flood fighting agency. The Corps provides assistance in three primary areas:



- regulatory authority over wetlands and waterways;
- flood reduction studies and their resulting cost-shared structural flood control projects; and
- emergency response and flood fighting services.

The Corps regulates development of wetlands and construction that affects waterways (including reconstruction, clearing and dredging) through permit programs established under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Generally, activities that include filling, excavation and land clearing using heavy equipment require some form of permit from the Corps.

The Corps is well-known in Lake County for the flood damage reduction studies they have done on the Des Plaines and Fox Rivers, and for the flood control reservoirs they have constructed on the North Branch of the Chicago River and Buffalo Creek. The Corps is currently conducting a feasibility study for constructing various flood control structures along the Des Plaines River.

The Corps also provides flood warning and actively monitors flood events. Staff can provide technical assistance, materials, equipment and personnel for flood fighting efforts during emergency response.

Private Organizations

American Red Cross



The American Red Cross (Red Cross) has one paid employee and 70 trained volunteers in Lake County. The Red Cross has an active recruitment and established training program for volunteers. Several of their volunteers have served for 40-50 years.

The Red Cross responds to all natural disasters. Staff have a wealth of printed guidance they distribute on flood response and recovery and other disaster topics.

Red Cross staff coordinate the provision of food and shelter to flood victims. They arrange shelter agreements with local schools and other public agencies and oversee the distribution of food, water, clothing and medication at these shelters and to people involved in the flood fighting effort. The Red Cross coordinates with the county Health Department for inspection of these facilities and services.

Other services provided by the Red Cross include:

- damage assessments,
- the distribution of clean-up kits, and
- directions for clean-up and reducing public health risk,
- flood damage assessments,
- guidance to residents on water testing for areas where wells are flooded, or where sewers backed up,
- supplying drinking water to affected residents.

Other volunteer organizations

In addition to the Red Cross, other volunteer organizations such as the Salvation Army and churches provide assistance in response to a flood event. Types of assistance they generally provide include food, shelter, clothing, labor and money. LCEMA maintains contact with many of these volunteer organizations and assists with coordination during flood response.

Flood Mitigation Task Force

It can be seen that there are many different public and private agencies and organizations that have been or can be partners in flood hazard mitigation.

It is important that their efforts be coordinated and that there is a unified approach to projects and funding priorities. Therefore, this *Plan* proposes a Lake County Flood Mitigation Task Force.

Duties

The Task Force would be responsible for the following:

1. Conduct periodic meetings to review the status of flood mitigation activities in the County,
2. Review progress toward implementation of the action items in this *Plan* and recommend appropriate changes to the responsible agency or organization,
3. Prepare a list of potential pre-flood and post-flood mitigation projects and recommend priorities for funding of those projects,

4. Monitor the preparation and implementation of more detailed site-specific plans and municipal mitigation plans and provide advice to the responsible agency or organization,
5. Provide a forum for exchanging information and discussing new ideas in the field of mitigation,
6. Provide a conduit for information on new developments in State and Federal programs, and
7. Prepare an annual report to the Stormwater Management Commission, the Lake County Municipal League, and the County Board on the status of this *Plan* and its action items.

Composition

The Flood Mitigation Task Force would be a committee of the Lake County Stormwater Management Commission, similar to the current Technical Advisory Committee. It's members would be the heads of the following partner agencies and/or their alternates:

- SMC
- LCEMA
- ...
- ...
- ...
- ...
- ...

Operations

Initially, the Chair of the Task Force would be an SMC Commissioner, appointed by the SMC Chair. Over time, the Task Force may opt to elect a Chair and other officers. The SMC would also provide staff support, such as taking minutes and sending out meeting notices.

Because the Task Force would be primarily devoted to coordinating programs, settling technical issues, recommending actions and funding priorities, and monitoring and reporting on projects, it is expected that most decisions would be based on the technical aspects of the issues and determined by consensus of those present.

All of the partners would be sent announcements and agendas for each meeting, minutes of the previous meeting, and copies of the annual reports and other Task Force products.

Powers

Because it is not a government agency, the Task Force's powers would be limited to such authority as is assigned to it by the SMC.

Otherwise, the Task Force's powers are advisory. It is expected that given the composition of the Task Force, its recommendations will carry some weight.

Annual Report

The annual report noted as the 7th duty of the Task Force would include:

- A review of each recommendation in the action plan, including a statement on how much was accomplished during the previous year;
- A discussion of why any action items were not accomplished or why implementation is behind schedule; and
- Recommendations for new action items or revised objectives.

Chapter 8. Action Plan

Flood Hazard Mitigation: Programmatic Action Plan Recommendations					
No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
<i>Flood Damage Remediation</i>					
1	Establish a county mitigation task force composed of representatives from the primary county agencies and municipalities involved in flood mitigation for purposes of setting priorities for use of state, federal and county flood mitigation funds.		P&D, SMC	EMA, DOT, PW, HD, MUNIS	
2	Establish guidelines for determining what mitigation measures are appropriate under various circumstances.		SMC	P&D, MUNIS	
3	Identify all structures located in flood hazard areas and set up a database for county and municipal use to contact property owners regarding their flood risk and mitigation options.		SMC	P&D MUNIS, EMA	
4	Collect lowest entry elevations and conduct flood audits for high priority flood problem areas to determine the measure(s) (acquisition, relocation, building elevation, floodproofing or other) that are most practical and cost effective in the long-term .		SMC	P&D MUNIS, EMA	
5	Inventory and prioritize buildings located in flood hazard areas that qualify for acquisition or relocation.		SMC	P&D, MUNIS	
6	Coordinate relocation/acquisition programs with other local and county-wide land acquisition programs including FPD, CDBG program, park districts and public works.		SMC	P&D, FPD, PW	
7	Develop, adopt and implement protocol for county-wide drainage system maintenance standards.		SMC	DOT, PW, MUNIS, DD	
8	Focus on improving septic system performance in public information efforts targeted to property owners in flood problem areas that experience septic failure.		SMC / HD	Red Cross	

No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
9	illicit hookups and sewer infiltration that includes maps and prioritizes problem areas for remediation.		PW/SMC	MUNIS	
10	Provide technical assistance at county level to municipalities and property owners for sewer backup mitigation.		PW/SMC	MUNIS	
11	Establish (or re-designate an existing) "high profile" flood proofing specialist position at the county level to advise and train county and municipal staff on recommending appropriate floodproofing measures and conducting flood audits.		County Board	P&D, EMA, SMC	
12	Provide incentive-based flood mitigation training program for appropriate county and municipal staff.		SMC	EMA, P&D	
13	Develop local floodproofing incentives program for property owners.		County Board	SMC	
14	Locate areas by subwatershed appropriate for regional detention sites.		SMC	MUNIS, P&D	
15	Establish county standards for design and construction of regional detention facilities that meet multi-objective criteria.		SMC	FPD, MUNIS, P&D	
16	Develop a county system for coordinating and funding regional structural flood control projects.		County Board	SMC, P&D MUNIS	
17	Provide a pool of county and community local cost-share funds (based on planning jurisdiction) to match state and federal dollars for mitigation.		County Board	MUNIS	

No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
<i>Flood Damage Prevention</i>					
18	Map natural drainage system on watershed-based county-wide conservation and development map that is incorporated into the WDO.		P&D	SMC, FPD	
19	Adopt separate zoning classification in UDO for floodplains, wetlands, drainage ways.		P&D	SMC	
20	Develop county-wide open space network map (that emphasizes protection of the natural drainage system) for adoption by municipalities and county.		FPD	P&D, SMC	
21	Incorporate open space network map into county, municipal and township land acquisition programs/plans.		FPD	MUNIS, TWNSHP	
22	Determine existing runoff rates and volume for each subwatershed to determine watershed-based allowable release rates.		SMC	P&D, MUNIS	
23	Complete comprehensive watershed plans that include multi-objective floodplain management for flood damage reduction for entire county.		SMC	P&D, MUNIS, TWNSHP	
24	All stormsewer improvements that result in increased drainage capacity should be reviewed on a watershed basis to address cumulative impacts.		SMC	MUNIS, P&D DOT, LCPW	
25	Aggregate all 1 or 2 ft topography and stream cross sections available from county, municipal, state & federal agencies.		SMC	P&D, DOT, LCPW, MUNIS	
26	Acquire missing topographic and cross section information for the county.		SMC	MUNIS, P&D	
27	Update out-of-date flood studies for county watersheds.		SMC	P&D MUNIS	
28	Complete accurate floodplain map (including 1st order streams and significant depressional areas) and submit to FEMA for adoption.		SMC	IDNR, FEMA	
29	Establish schedule and funding mechanism to keep flood studies and mapping up-to-date.		SMC	MUNIS, P&D, IDNR, FEMA	

No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
30	Develop system to tag addresses for floodplain, floodway or flood problem areas properties for review and permitting.		SMC	P&D, MUNIS	
31	Strengthen implementation of runoff volume reduction hierarchy in the WDO by providing density incentives through UDO and comparable municipal ordinances.		SMC	P&D	
32	Adapt county and municipal landscape requirements to encourage landscaping with deep-rooted native vegetation.		P&D, MUNIS		
33	Establish minimum requirements for topsoil replacement to improve infiltration on developed sites.		SMC	P&D, MUNIS	
34	Improve timing and performance for soil erosion and sediment control practices at the county and community level.		SMC	P&D, MUNIS	
35	provisions of the Watershed Development Ordinance to match Corps General Permit requirements and includes a goal of no-net-loss of wetlands.		SMC	P&D, MUNIS	
36	Require mitigation or fee-in-lieu of mitigation for all wetland impacts associated with development.		SMC	P&D, MUNIS	
37	Increase wetland and stream buffer widths in WDO and require use and deed restrictions on wetlands and buffer areas (develop a map set for all deed restricted areas).		SMC	P&D, MUNIS	
38	Establish county program to restore wetlands.		SMC	P&D, MUNIS	
39	Adopt county-wide best management practice standards for maintenance of channelized rivers and streams.		SMC	DD, MUNIS, P&D, HD	
40	Increase outreach to community plan departments and commissions to strengthen local understanding and review of development proposals and their compliance with WDO and wetland regulatory standards.		SMC	NRCS, SWCD, ACOE	

No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
41	Develop continuing training requirements for community WDO enforcement officers and engineers to improve consistency in application and review of WDO standards.		SMC	MUNIS, P&D	
42	Coordinate /incorporate SMC review of development proposals early in the process to insure appropriate runoff reduction BMPs are incorporated into development designs.		MUNIS, P&D, SMC		
43	Incorporate monitoring and evaluation of BMP effectiveness in WDO permits.		SMC	P&D, MUNIS	
44	Create Special Service Areas so Townships can collect utility fees to maintain detention ponds and other components of the drainage system in unincorporated areas.		P&D	TWNSHP, SMC	
5.2.3 Emergency Response					
45	Improve accessibility of rain and stream gage information and provide training to increase municipal and county use of information.		SMC	EMA	
46	Set up local automated fax notice warning system that includes all municipalities, townships, county agencies and critical facilities at flood risk.		EMA	SMC	
47	Incorporate proactive response activities in emergency plans. Examples include: checking sites of known drainage constrictions, monitoring lake levels, and providing guidance to property owners on when and how to turn off utilities.		EMA	Utility Co., DOT, PW, MUNIS, DD, Lake Assoc.	
48	Install alarm systems on lift stations.		LCPW	MUNIS	
49	Map all critical transportation routes subject to flooding and planned detours.		DOT	EMA	
50	Identify and map all critical facilities located in flood prone areas.		SMC	EMA	
51	Identify and map all hazardous storage sites located in flood prone areas.		EMA	SMC	

No.	Recommendation	Priority ¹	Lead Agency ²	Supporting Agency(s) ²	Target Date
52	Implement a system of flood damage reporting by the county, townships and municipalities in a computerized database format.		EMA	COUNTY, MUNIS, TWNShP, DOT	
53	Add a "Flood Annex" to the <i>Lake County Emergency Operations & Preparedness Plan</i> .		SMC	EMA	
Public Outreach					
54	Build a county-wide partnership for coordinated delivery of public information materials and flood mitigation programs that target communities and property owners at risk.		SMC	P&D, HD, Red Cross, EMA	
55	Expand "Flood Awareness Week" with more activities for the general public.		SMC	EMA, HD, Red Cross	
56	Build a flood mitigation display on property protection measures for partnership to use at home shows and the county fair.		SMC	EMA, HD, Red Cross	
57	Plan and conduct an open house on property protection measures.		SMC, EMA	P&D, MUNIS	
58	Conduct training programs for lake and homeowner associations in flood response.		SMC, EMA	DD, HD, Lake Assoc, Red Cross	
59	Educate and provide information and maps on flood hazard areas and wetlands to realtors and appraisers to improve real estate disclosure.		SMC	P&D, MUNIS	
60	Tie flood hazard areas into township tax files for disclosure purposes.		TWNShP	SMC	
	¹ High, Medium or Low				
	² SMC = Stormwater Management Commission	IDNR = Illinois Department of Natural Resources			
	P&D = Planning & Development Department	FEMA = Federal Emergency Management Agency			
	DOT = Lake Co. Department of Transportation	SWCD = Soil & Water Conservation District			
	PW = Lake Co. Department of Public Works	ACOE = Army Corps of Engineers			
	FPD = Lake Co. Forest Preserve District	NRCS = Natural Resources Conservation Service			
	EMA = Lake Co. Emergency Management Agency				
	MUNIS = Municipalities				
	TWNShP = Townships				

Flood Hazard Mitigation Site Action Plan Priorities

Flood Problem Areas by Priority Category

VERY HIGH PRIORITY

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
1	26	Fox R. Springs	Antioch Township/Lake County	Overbank - Fox River			
1	29	Channel Lake Bluffs	Antioch Township/Lake County	Overbank - Channel Lake	\$71,000 (improved conveyance system)		
1	38	Volk Bross's Midlake	Antioch Township/Lake County	Overbank - Channel/Marie Lakes			
1	39	1st Add Lakeview Sub	Antioch Township/Lake County	Overbank - Lake Marie			
1	45	Lippincott Rd	Fox Lake	Local drainage	\$300,000 (reconstructed stormsewer)	CDBG	
4	14	SW Rollins/Hainesville	Round Lake Beach	Depressional	\$100,000 (lift station on Melrose)	CDBG/Village	
4	17	Round Lake Drain	Round Lake Beach	Overbank - Round Lake Drain			
4	18	NW Round Lake B	Round Lake Beach	Depressional	added stormsewer		
4	19	W Cedar Lake, S Rollins	Round Lake Beach	Depressional			
4	21	Shorewood Sub	Avon Township/Lake County	Local drainage			
4	28	Alpine Dr	Round Lake	Local drainage	\$250,000 (sanitary sewer upgrade, manholes, stormsewer replaced swales)	CDBG	
4	30	Cedar Lake Rd	Round Lake	Sewer backup	\$10,5000 (sanitary sewer rehabilitation)	CDBG	
5	1	Mvers Bay	Grant Township/Lake County	Overbank - Pislakee Lake	Some homes elevated on Sheridan		
5	4	Eagle Point	Fox Lake	Overbank - Pislakee Lake			
7	1	Williams Park	Wauconda Township	Depressional	\$4 mil. (purchase and removal of homes)	EMA/CDBG/SMC	

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
11	15	Behn Dr	Grayslake	Depressional	stormsewer/sandbag		
13	17	Boulevard/Crescent	Gurnee	Sewer backup	basement pumps/lift station	Village	
18	3	Libertyville East	Libertyville Township	Overbank - Des Plaines sewer	stormsewer/sandbag	CDBG	
18	18	Libertyville East	Libertyville Township	Overbank - Des Plaines sewer	stormsewer/sandbag	CDBG	
18	18	Libertyville East	Libertyville Township	Overbank - Des Plaines sewer	stormsewer/sandbag	CDBG	
13	28	Russell Rd	Newport Township/Lake County	Overbank - Des Plaines			
15	3	Forest Lake Sub	Elia Township	Depressional	\$~400,000 (stormsewer)	SMC, CDBG	
16	1	Elmwood	Elmwood Township	Depressional			
16	10	Posselt Cr	Riverwoods	Overbank - Des Plaines	pumps/dikes/levees	Homeowner	
20	6	Lake of Gardens	Waukegan	Sewer backup	repair sewer as needed		
20	8	23rd	Zion	Sewer backup	\$125,000 (sanitary sewer)	CDBG	
20	10	N&S 3rd	Zion	Sewer backup	\$160,000 (sanitary sewer, water main, stormsewer improvements)	CDBG	
21	6	Lake of Gardens 1	Waukegan	Sewer backup	study - new line and line repair	City	
21	8	Summit/Orchard	Waukegan	Depressional			
22	3	SW 1st/18th	North Chicago	Local drainage	studied	City	
22	4	Jackman/18th	North Chicago	Depressional	studied	City	
24	1	Washington St	Waukegan	Local drainage	\$100,000 (improved drainage/water main) \$35,000 (floodwater storage feasibility study)	CDBG/ SMC/ Drainage District/ Waukegan/ Park City	

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
24	8	Trailways Sub	Highland Park	Overbank - Skokie River	studied		
25	1	Delmar Woods	W. Deerfield Township/Lake County	Depressional	\$887,000 (\$362,500 study, stormsewer line, swale)	SMC/State	
HIGH PRIORITY							
1	4	Atwater Pkwy	Fox Lake	Overbank - Fox Lake			
1	5	Lakeside Ln	Fox Lake	Overbank - Fox Lake			
1	10	Chesney Shores	Lake Villa	Depressional	\$75,000 (study, stormsewer)	CDBG/Township/Homeowners	
1	16	Simon Klondike	Antioch Township/Lake County	Overbank - Fox River			
1	22	Farrin's/Heart o'Lakes	Antioch Township/Lake County	Overbank - Grass Lake			
1	24	Reshaven Sub	Antioch Township/Lake County	Overbank - Petite Lake			
1	27	Woodcrest Sub	Antioch Township/Lake County	Overbank - Channel Lake	partial drainage improvement		
1	30	Channel Oaks Sub	Antioch Township/Lake County	Overbank - Channel Lake			
1	34	Felter's Sub	Antioch Township/Lake County	Local Drainage	\$76,000 or \$155,000 (drainage improvements)		
1	37	Channel Lakes Sh.	Antioch Township/Lake County	Overbank - Channel Lake			
1	43	Rollins/Medhan	Fox Lake	Overbank - Fox Lake	\$27,700 (dredged channel)	CDBG	
1	48	Beach Grove Rd	Antioch Township/Lake County	Overbank - Bluff Lake			
2	3	Crooked Lake Park	Lake Villa Township/Lake County	Local drainage	partial (Linden Ave.)		
2	4	Grand Ave	Lake Villa	Depressional	\$375,000		

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W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
2	8	Oakwood Knolls Sub	Antioch	Sewer backup	\$150,000 (drainage improvements, basement plugs)	CDBG/owners	
2	10	N of Loon Lake	Antioch Township/Lake County	Depressional			
3	2	Knollwood Sub	Fox Lake	Overbank - Fox Lake			
3	7	N Romans/ E Wilson	Grant Township/Lake County	Depressional	road improvements		
3	8	SE Duck Lake	Grant Township/Lake County	Overbank - Duck Lake	\$100,000 (water mains, some homes elevated)	CDBG/owners	
3	11	E Webster Lake	Grant Township/Lake County	Local Drainage			
4	4	Lakeview Dr	Round Lake	Overbank - Round Lake			
4	6	Ace Hardware	Round Lake	Depressional	\$100,000 (stormsewer, curb & gutter)	CDBG	
4	7	Arrowhead & Tomahawk	Round Lake Heights	Depressional	\$450,000 (detention facility)	CDBG	
4	9	Murphy Elem. School	Round Lake Park	Depressional	\$500,000 (Greenwood pump station, stormsewers)	CDBG (\$250K)	
4	11	Prospect Dr	Round Lake Park	Local drainage			
4	12	Fairview Dr	Round Lake Park	Local drainage			
4	13	Shorewood Sub	Round Lake Beach	Overbank - Highland Lake Drain)			
4	15	Round Lake Drain W	Round Lake Beach	Overbank - Round Lake Drain			
4	20	Round Lake Drain E	Round Lake Beach	Overbank - Round Lake Drain			
4	29	Lincroft & Park	Round Lake	Sewer backup	\$125,000 (sanitary sewer and manhole rehab)	CDBG	
4	37	Holmes Ave	Grant Township/Lake County	Overbank - Squaw Creek	some have raised seawalls	owners	
4	44	W of Round Lake	Round Lake Beach	Depressional			
5	2	Crockett Estates	Grant Township/Lake County	Overbank - Pistakee Lake			

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
5	5	Queens/Cedar Isles	Grant Township/Lake County	Overbank - Pistakee Lake	some homes elevated	owners	
5	6	Kings Island	Fox Lake	Overbank - Pistakee Lake			
5	8	Round Hills Sub	Fox Lake	Overbank - Pistakee Lake			
7	4	Lakeview Villa	Wauconda	Overbank - Bangs Lake			
7	9	Forest Garden	Wauconda Township/Lake County	Local drainage	(berm, tile and swale - \$1,500)		
8	1	Rock Tree Creek	Cuba Township/Lake County	Local drainage	\$120,000 (catch basin)	CDBG	
8	2	Normandy Pt	Cuba Township/Lake County	Depressional	study		
8	3	River Glen Sub	Cuba Township/Lake County	Local drainage	\$40,000 study		
8	4	Snuff Valley	Cuba Township/Lake County	Overbank - Fox River			
8	5	Kelsey Grove Sub	Cuba Township/Lake County	Overbank - Fox River	\$15,000-20,000 (partial - catch basins, culverts)		
8	15	Brierwoods Est	Hawthorn Woods	Local drainage	study, partial drainage system upgrade		
8	17	Frisch's Sub	Cuba Township/Lake County	Overbank - Fox River			
8	18	Hickory Nut Grove	Cuba Township/Lake County	Local drainage			
9	4	Old Barrington Rd	Cuba Township/Lake County	Local drainage	\$25,000 (partial - drain tiles/catch basins)		
9	13	Miller/Northcrest Rd	Lake Zurich	Local drainage	study planned		
9	15	Golf View Rd	Lake Zurich	Local drainage	topo survey - design planned		
11	7	Hillside/First St	Grayslake	Depressional	\$500,000 (plan, stormsewers)	Village	
11	8	Manor Lake	Grayslake	Depressional	study, stormsewer, regraded street swale		

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W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
11	14	Granwood Park	Warren Township/Lake County	Local drainage			
12	3	W. Greenbay/29th	Beach Park	Local drainage	plan drainage upgrade		
13	1	Sheridan Ave	Waukegan Township/Lake County	Depressional	plan to add stormsewer		
13	5	Shirley/Meyer	Warren Township/Lake County	Overbank - Country Club Trib.	\$87,700 (box culverts, channel clearing)	CDBG/SMC/Township	
13	8	Twin Lakes	Warren Township/Lake County	Overbank - Twin Lakes	\$101,000 (stormsewers, expanded detention)	CDBG/Park District	
13	9	Royal Oaks Apt	Warren Township/Lake County	Depressional	stormsewers improved		
13	13	Wilson Area	Warren Township/Lake County	Depressional			
15	5	Courtland St.	Mundelein	Overbank - Seavey Drain	\$2 million (study, channel improvements, wetland restoration)	Village	
15	6	Division St Corridor	Mundelein	Local drainage			
15	10	Circle Dr	Hawthorn Woods	Local drainage	\$40,000 (stormsewers)	Village	
16	4	Lincolnshire Dr	Lincolnshire	Overbank - Des Plaines	stormwater pump		
16	8	Mearns Lake Sub	Riverwoods	Overbank - Des Plaines			
17	2	Sturt Sub	Elgin Township/Lake County	Depressional	\$1mil (new detention)	SMC/Township/IDF/County/IEMA	
18	1	Pekah Sub	Vernon Township	Overbank - Des Plaines/Aptakisic	studied Des Plaines Phase I		

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
						CDBG/ Drainage District/ Village	
20	3	S Beach Rd	Beach Park	Local drainage	\$275,000 (stormsewers)		
20	9	20th-23rd	Zion	Sewer backup	study		
21	2	Crescent	Waukegan	Local drainage	study, partial - detention pond		
21	3	Pine & Ridgeland	Waukegan	Depressional	area plan		
21	4	Circle Tree Apt	Waukegan	Local drainage	area plan		
21	5	Frolic/Brooke	Waukegan	Local drainage	stormsewer		
21	7	Dodge/Lewis	Waukegan	Local drainage			
23	1	Frost/Western Av	Lake Forest	Local drainage	stormsewer upgrade planned		
23	2	Western Av N	Lake Forest	Local drainage	combination new stormsewers, upgrade, detention		
23	5	Western/IL/College	Lake Forest	Local drainage	new stormsewer		
24	2	WKRS Radio	Waukegan	Depressional			
24	9	Taylor Ave	Highland Park	Overbank - Skokie River	plan		
24	10	Deerfield Villa/Sunset Manor	Highland Park	Overbank - Skokie River	plan		
24	13	PW & Bartlett Sub	Shields Township/Lake County	Local drainage	plan	CDBG	
24	14	Knollwood Sub	Shields Township/Lake County	Local drainage	\$75,000 plan, ditch cleaned	CDBG	
24	18	Forest Hill Rd	Lake Forest	Local drainage	plan		
25	3	Arcady Dr	Lake Forest	Local drainage	plan		
25	4	Lexington Dr	Lake Forest	Overbank - Middle Fork	plan		
25	5	Kenton Lane	Green Oaks	Overbank - Doe Lake	plan	Village/ SMC CCE/ Drainage District FPD	
26	1	Forestway Dr	Deerfield	Overbank - West Fork	reservoir		

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W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
MEDIUM PRIORITY							
1	1	Holly Ave	Fox Lake	Overbank - Fox Lake	\$30,000 (cleared culvert, built up bridge, stabilized bank)	CDBG	
1	2	Stanley Pt.	Grant Township/Lake County	Overbank - Fox Lake			
1	6	Lakeview Av	Fox Lake	Overbank - Fox Lake	\$250,000 (stormsewer wth curb & gutter)	CDBG	
1	7	Maple Av	Fox Lake	Overbank - Fox Lake			
1	8	Sheriff's Base	Fox Lake	Overbank - Fox Lake			Sheriff's Department
1	11	Chesley Shores	Lake Villa Township/Lake County	Depressional	repaired manholes, larger stormsewer		
1	12	Orchard Gardens	Lake Villa Township/Lake County	Local drainage	\$200,000 (water mains, improved drainage)	CDBG/LCPW?	
1	13	Columbia Bay Dr	Lake Villa Township/Lake County	Local drainage	drainage/stormsewer improvements	Township	
1	14	Fox Lake Vista	Antioch Township/Lake County	Overbank - Dunn's Lake channel	roads reconstructed with drainage		
1	17	Selton's Sub	Antioch Township/Lake County	Overbank - Grass Lake	channel dredged	Fox Waterway Agency	
1	18	Serotonins Sub	Antioch Township/Lake County	Overbank - Fox Lake			
1	19	J L Snow's Sub	Antioch Township/Lake County	Overbank - Fox Lake			
1	20	Ramaker's Sub	Antioch Township/Lake County	Overbank - Fox Lake	new storm drain		
1	23	Louis Forbrich's Sub	Antioch Township/Lake County	Overbank - Lake Marie			
1	25	Courtesy Club Sub	Antioch Township/Lake County	Overbank - Bluff Lake			
1	28	Shannon's 1st add	Antioch Township/Lake County	Overbank - Channel Lake			

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
1	31	Rt. 173	Antioch Township/Lake County	Overbank - Lake Marie			
1	35	Grandview Sub	Antioch Township/Lake County	Overbank - Lake Catherine	\$40,000 (remove sediment in channel, provide outlets)		
1	42	W side Rt 83	Antioch	Depressional			
1	44	S Cora Ave	Fox Lake	Local drainage	\$37,600 (put in detention)	CDBG	
1	46	Kidd Dr.	Antioch Township/Lake County	Overbank - Trevor Creek	seawall one side		
1	49	Warriner's Sub	Antioch Township/Lake County	Local drainage	part of \$500,000 (improved roads/drainage)	CDBG	
2	1	Cedar Lake Park	Lake Villa Township/Lake County	Local drainage	partial - replaced stormsewer line		
2	5	Shorewood/Burnett	Lake Villa	Depressional	new stormsewer		
2	7	Rt 173 Sequoit Cr	Antioch/Antioch Township/Lake County	Overbank - Sequoit Creek			
2	9	SE of E Loon Lake	Antioch Township/Lake County	Depressional			
2	12	Lake Shore Dr	Antioch Township/Lake County	Local drainage	\$200,000 (road improvements/stormsewers)	CDBG	
3	3	Wildwood Sub	Fox Lake	Overbank - Duck Lake	rip-rap of cave-in	IDOT	
3	4	Elm Ave.	Fox Lake	Sewer backup			
3	6	Squaw Creek outlet	Grant Township/Lake County	Overbank - Long Lake			
4	2	Caine's Woods	Lake Villa Township/Lake County	Local drainage			
4	5	Midland Dr	Round Lake	Depressional			
4	10	Elder, Forest Glen, Prospect	Round Lake Park	Depressional	\$130,000 (partial - stormsewer, watermain)	CDBG	
4	16	Oakwood Dr	Round Lake Beach	Depressional	\$100,000 (pump station/relief sewer)	CDBG	
4	24	Forest Glen Drive	Round Lake Park	Sewer backup	\$82,500 (sanitary lift station)	CDBG	
4	25	Lakeside Dr	Avon Township/Lake County	Overbank - Highland Lake			

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W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
4	27	Fairfield Rd	Avon Township/Lake County	Local drainage	\$13,100 (tile drain replacement)	SMC/LCDOT	
4	31	RL F 37/ Magee MS	Round Lake	Depressional			
4	33	Nippersink & Com Ed	Round Lake	Depressional	plan		
4	35	Villa Vista Dr	Round Lake Beach	Depressional			
4	38	Long Ave	Grant Township/Lake County	Overbank			
4	41	Renwood Golf Course	Round Lake Beach	Overbank - Highland Lake Drain			
7	2	Ivanhoe Road	Wauconda Township/Lake County	Depressional			
7	5	Hubbard's Woods	Wauconda	Local drainage	study		
7	6	Larkdale Sub	Wauconda	Local drainage	study		
7	7	Larkdale Sub	Wauconda	Local drainage			
7	10	Lakewood Est.	Lake Barrington	Overbank - Slocum	plan	Drainage District	
8	9	Oxford Rd	Tower Lakes	Depressional	partial - clean pipes		
8	14	Warwick Rd	Tower Lakes	Depressional			
8	19	Pioneer Grove Rd	Cuba Township/Lake County	Depressional	plan		
9	1	Chicago Highlands	Cuba Township/Lake County	Depressional			
9	3	Hartford Rd	Cuba Township/Lake County	Local drainage	partial - fixed drain tile		
9	5	Cuba Rd	Cuba Township/Lake County	Local drainage			LCDOT
9	6	Barbara Bensen	Cuba Township/Lake County	Local drainage			
9	7	Bell Orchard	Lake Zurich	Depressional	\$5,000 (control structure/perforated riser)		
9	9	Clover Hill Rd	Lake Zurich	Depressional			
9	10	Shaw Grove Ln	Lake Zurich	Depressional			
9	12	Echo Lake Sub	Ela Township/Lake County	Local drainage			

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
9	14	Pine Tree	Lake Zurich	Local drainage			
9	16	Alpine Dr	Lake Zurich	Local drainage	design plan		
10	1	Venetian Village/Rose Tree	Lindenhurst	Depressional			
10	2	W. Miltmore	Lake Villa Township/Lake County	Local drainage	plan		
11	1	W Miltmore	Lake Villa Township/Lake County	Depressional			
11	4	Venetian Village	Lindenhurst	Local drainage			
11	6	Venetian Village	Lindenhurst	Local drainage	curb & gutter		
11	11	Grandwood Dr	Warren Township/Lake County	Local drainage	plan		
11	13	Grandwood Park	Warren Township/Lake County	Local drainage			
11	18	Wright Av	Warren Township/Lake County	Depressional			
12	5	Birchwood Est	Wadsworth	Depressional			
12	7	21st St	Newport Township/Lake County	Overbank - Newport Drain			
13	2	Countryside Manor	Libertyville Township/Lake County	Overbank - Des Plaines	swale reconstructed	SMC/Township	
13	4	Green Place	Waukegan	Local drainage	additional detention		
13	11	Arbor Vista	Warren Township/Lake County	Depressional	stormsewer	Township	
13	15	Grove Av	Gurnee	Overbank - Des Plaines	\$87,650 (channel/stormsewer improvements)	CDBG	
13	16	Country Club Av	Gurnee	Depressional	\$20,000 (stormsewer)	SMC	
13	19	Greenleaf Creek	Park City	Overbank - Greenleaf Creek	\$35,000 (stabilized toe, channel maintenance)	CDBG/IEPA/Village	
13	21	Oak Spring Road	Libertyville	Overbank - Des Plaines			
13	23	W Green Bay/Blanchard	Warren Township/Lake County	Depressional	\$27,700 (stream channel maintenance study)	SMC	

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W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
14	1	Brookmill Sub	Libertyville Township/Lake County	Overbank - Bull Creek			
15	2	Oak Terrace Sub	Libertyville Township/Lake County	Local drainage	plan		
15	4	Indian Meadows	Elk Township/Lake County	Local drainage	culvert retrofit?	LCDOT/ SMC/ County/ Township	
15	13	Valley Rd	Indian Creek	Local drainage			
16	2	45 Londonderry	Lincolnshire	Overbank - Des Plaines	tear down old police dept.		Lincolnshire Police
16	3	Stonegate Sub	Lincolnshire	Overbank - Des Plaines	1. house raised, stormsewer, bridge raised		
16	5	Rivershire Ln	Lincolnshire	Overbank - Des Plaines			
16	6	Copeland Manor	Libertyville	Overbank - Des Plaines			
16	7	Forest Glen Trail	Riverwoods	Local drainage			
17	1	Ranch Acres	Elk Township/Lake County	Local drainage	new inlets and road culvert		
20	1	Wadsworth Rd	Beach Park	Local drainage	plan (road culvert replaced)	LCDOT/ Village	
20	2	Coolidge	Beach Park	Local drainage	stormsewer	Village	
20	7	30th/ Lewis	Zion	Local drainage	plan for channel		
20	11	North Av	Beach Park	Local drainage	\$150,000 (stormsewer along N Shore Path)		
21	9	Waukegan R S 120	Waukegan	Overbank - S Branch Waukegan R			
21	14	Lincoln & 11th	North Chicago	Local drainage	partial - stormsewer improvement		
21	15	S Grand/W Keller	Waukegan	Local drainage			
22	1	Lakefront Hwy/24th	North Chicago	Overbank - Pettibone Creek	plan to improve flow in channel		

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
24	3	Abbott/Com Ed	North Chicago	Local drainage	detention pond/stormsewer improvements	LCDOT/Drainage District	
24	4	41 & Bonaparte	North Chicago	Local drainage	road drainage	IDOT	
24	5	Teske & Dixie	Park City	Local drainage	\$35,000 (floodwater storage feasibility study)	SMC/Drainage District/Waukegan/Park City	
24	7	41 & Deerpath	Lake Forest	Local drainage	stormsewer/detention/lift station capacity	IDOT/City	
24	11	Bartlett Sub	Shields Township/Lake County	Depressional	\$65,000 (stormsewer/open swale)	Township/SMC	
24	15	Forrestal VII	Great Lakes Naval Base	Overbank - Skokie River			
24	16	Willow Glen GC	Great Lakes Naval Base	Overbank - Skokie River			
25	2	Tanglewood/Conway	Lake Forest	Depressional	large culverts installed		
25	6	Atkinson Rd	Green Oaks	Depressional	new culvert/clean ditch		
25	12	Briargate	Highland Park	Overbank - Middle Fork			
26	2	W Fork Dr	Lake Forest	Overbank - West Fork	plan (berm)		
26	3	Duffy Ln	Riverwoods	Local drainage	study		
26	4	W Course Dr	Riverwoods	Overbank - West Fork	retrofit Reservoir 27	COE/Deerfield	
26	5	Deerpath Dr	Deerfield	Overbank - West Fork	retrofit Reservoir 29A	COE/Deerfield	
LOW PRIORITY							
1	15	Lotus Woods	Antioch Township/Lake County	Overbank - Dunn's Lake channel	\$202,700 (road and stormsewer upgrade)	CDBG	
1	21	Lotus Park	Antioch Township/Lake County	Overbank - Grass Lake			

-DRAFT -

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
1	32	Calif. Ice & Coal	Antioch Township/Lake County	Overbank - Lake Marie	\$88,000 (outlets, culverts, ditches/sewers)	CDBG	
1	33	Crane Hill's Sub	Antioch Township/Lake County	Overbank - Lake Catherine	\$107,700 (outlets, culverts, ditches/sewers)	CDBG	
1	36	Morley's Sub	Antioch Township/Lake County	Overbank - Trevor Creek	\$45,800 (outlets, culverts, ditches)		
1	40	Trevor Rd	Antioch	Depressional			
1	41	Trevor Rd	Antioch	Depressional			
1	47	Sibley Dr	Antioch Township/Lake County	Overbank - Spring Lake			
2	2	N Shore Cedar Lake	Lake Villa Township/Lake County	Local drainage			
2	6	Petite Lake Rd	Lake Villa/Lake County (road)	Depressional			
2	11	4156 N Rt 59	Antioch Township/Lake County	Depressional			
3	1	Fossil St.	Fox Lake	Overbank - Squaw Creek			
3	5	Lincoln Av	Fox Lake	Sewer backup			
4	1	Long Beach Dr	Grant Township/Lake County	Local drainage	\$95,000	CDBG/ Township	
4	3	39 Laurie Court	Lake Villa	Depressional			
4	22	Bacon Road	Avon Township/Lake County	Local drainage	partial - culvert replaced		
4	23	Bacon Road	Avon Township/Lake County	Depressional			
4	26	Harrison Ave	Round Lake/Avon Township/Lake County	Depressional	new stormsewer hookup		
4	32	Nippersink Rd	Round Lake	Overbank - Mud Lake tributary			
4	34	Hawley St	Fremont Township/ Lake County	Depressional	Plan		
4	36	Milwaukee Ave	Grant Township/Lake County	Overbank - Long Lake			

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
4	39	Catherine Rd	Grant Township/Lake County	Depressional			
4	42	Jean Hain Park	Round Lake	Depressional			
5	3	Hilldale Manor	Grant Township/Lake County	Overbank - Pistakee Lake			
5	7	Causeway Pistakee	Fox Lake	Overbank - Pistakee Lake			
6	2	Eastway Dr	Island Lake	Overbank - Mutton Creek	\$154,000+ (box culverts, storm drains, manholes, inlets)	CDBG/ local	
6	3	Darrell Rd	Wauconda Township/Lake County	Depressional			
7	3	Mylith Park	Wauconda Township/Lake County	Depressional	\$225,000 (road upgrades, stormsewers)	CDBG/ SMC	
8	6	Timber Lake Rd	Cuba Township/Lake County	Local drainage			
8	7	Leon/Esther Dr	Tower Lakes	Local drainage	\$60,000 (upgrade stormsewer)		
8	8	Circle Dr	Tower Lakes	Local drainage			
8	10	Melrose Dr	Tower Lakes	Local drainage			
8	11	Roberts/Paddock Rd	Tower Lakes	Local drainage			
8	12	E Lake Shore Dr	Tower Lakes	Local drainage			
8	16	Steeplechase Dr	Hawthorn Woods	Local drainage			
9	2	Fair Haven Sub	Cuba Township/Lake County	Overbank - pond			
9	11	Miller Rd Sub	Lake Zurich	Local drainage			
9	17	Miller Rd	North Barrington/Lake County (road)	Depressional			
9	18	Police/Fire Station	Barrington	Depressional	stormsewer upgrade		
9	21	Hart Rd	Cuba Township/Lake County	Depressional	partial? - culverts replaced		
11	3	Venetian Village	Lindenhurst	Depressional			
11	9	Linden Av	Avon Township/Lake County	Depressional	partial - road raised		
11	10	Shorewood Rd	Avon Township/Lake County	Depressional			

-DRAFT -

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
11	12	Granwood Park Sub	Warren Township/Lake County	Local drainage	sandbag		
11	19	Dorchester/Cambridge	Grayslake	Local drainage			
12	1	Adams Rd	Wadsworth (road)	Overbank - Newport Drain			
12	4	9th & Delany	Wadsworth (road)	Depressional			
13	6	Woodview	Green Oaks	Local drainage			
13	10	Gagewood Lane	Warren Township/Lake County	Overbank - Des Plaines tributary			
13	12	Orchard Valley	Warren Township/Lake County	Local drainage			
13	14	Kaiser Rd	Newport Township/Lake County	Depressional			
13	20	Lake Minear	Libertyville	Overbank - Lake Minear			
13	26	Gage Lake Rd	Warren Township/Lake County (road)	Depressional			
15	1	Diamond Lake Creek	Fremont Township/ Lake County	Overbank - Diamond Lake Creek	stream maintenance?	Township Highway/ SMC	
15	7	Diamond Lake Dr	Mundelein	Local drainage			
15	8	Marriott/Lincolnshire	Lincolnshire	Overbank - Indian Creek			
15	9	Hawthorn Knolls Sub	Hawthorn Woods	Local drainage	partial - stormsewer		
15	11	Lynn	Hawthorn Woods	Local drainage			
15	12	Gilman & Owens	Fremont Township/ Lake County	Local drainage	adjacent development?		
15	14	Township Sub	Long Grove	Local drainage			
17	3	Rt 12 Old Rand	Lake Zurich (road)	Local drainage			
18	2	Chevy Chase Dr	Vernon Township/Lake County	Depressional	road raised		
19	1	Zion Park	Zion	Overbank - Kellogg Creek	engineering study		
20	4	Monarch Pt	Beach Park	Local drainage	\$200,000 (stormsewer)	CDBG	

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
20	12	Zion Industrial Park	Zion	Depressional	engineering study		
21	1	Sunset/Lewis	Beach Park	Local drainage			
21	11	Foss Park Av	North Chicago	Local drainage	Plan		
21	13	Sheridan Rd	North Chicago	Local drainage			
22	2	Pettibone GLNTC	Great Lakes Naval Training Center	Erosion - Pettibone Creek	road repair		
23	3	Rt 176	Lake Bluff	Depressional - underpass			
24	12	Bartlett Sub	Shields Township/Lake County	Local drainage	stormsewer		
24	19	Golf Lane	Lake Forest	Overbank - Skokie River			
25	8	Woodvale Av	Deerfield	Overbank - Middle Fork			
25	9	Valley Rd	Bannockburn	Local drainage	maintenance, eliminate sump connections to sanitary		
25	10	Aitken Dr	Bannockburn	Depressional	maintenance, stormsewer improvements		
25	13	Tanglewood Ct	Highland Park	Overbank - Middle Fork			
VERY LOW PRIORITY							
1	3	Brodie Sub	Grant Township/Lake County	Overbank Fox Lake			
1	9	Gavin N School	Lake Villa Township/Lake County	Depressional			
1	50	Briar, 3rd & Rowe	Antioch Township/Lake County	Depressional			
3	9	Wooster Lake outlet	Grant Township/Lake County	Erosion - Wooster Lake outlet			
3	10	S Wooster Lake	Grant Township/Lake County	Depressional	house raised		
3	12	Hickory Ave	Fox Lake	Local drainage	\$75,000 (stormsewers)	CDBG	
4	8	Mohawk Dr	Round Lake Heights	Local drainage	upgraded stormsewer w/ new development		

-DRAFT -

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
4	40	Lake Ave	Avon Township/Lake County	Overbank - Highland Lake drain	culvert added		
4	43	Cambell Airport	Fremont Township/Lake County	Overbank - Squaw Creek			
6	1	Chicago Sea Ray	Lakemoor	Local drainage			
7	8	Mill St	Wauconda	Local drainage	\$35,000 (stormsewer upgrade)	CDBG	
8	13	Courty Club Est	Tower Lakes	Local drainage			
9	8	Rt 22 W of 12	Lake Zurich	Local drainage	pipe upsized		
9	19	Jewel Park	Barrington	Overbank - Flint Creek			
9	20	Oak Knoll Rd	Barrington Hills	Overbank - Flint Creek			
9	22	Signal Hill Rd	Cuba Township/Lake County	Local drainage	\$7,000 (culverts and catch basins)		
11	5	Venezian Village	Lindenhurst	Depressional			
11	16	Hunt Club Rd	Old Mill Creek/Lake County road	Local drainage			
11	17	Washington St	Warren Township/Lake County road	Local drainage			
12	2	Waverly St.	Beach Park	Depressional			
12	6	Delaware Rd	Newport Township/Lake County	Depressional	tile & swale	County/ Forest Preserve	
13	7	Woodland Meadows	Warren Township/Lake County	Depressional	sandbag/wetland outlet	SMC/ Homeowner's Assn.	
13	22	Liberty Drive	Libertyville	Overbank - Liberty Lake			
13	24	Terrence Fare Sub	Libertyville Township/Lake County	Local drainage	expanded pond		
13	25	Hunt Club Rd	Old Mill Creek/Lake County road	Depressional			
13	27	Belvidere Rd	Warren Township/Lake County	Overbank - Des Plaines			
13	29	Margate Rd	Green Oaks	Depressional			

W-shed	Site #	Site Name/Area	Community	Primary Cause of Flood Damage	Mitigation	Funding Source	Lead Responsibility
15	15	Hillside Sub	Ela Township/Lake County	Local drainage			
16	9	Estonian House	Vernon Township/Lake County	Overbank - Des Plaines			
17	4	Tree/White Pine Rd	Kildeer	Local drainage	engineering study		
20	5	N Lyons Woods	Beach Park	Local drainage			
23	4	HP Ravine	Highland Park	Erosion - ravine	\$10,000 demo project?		
24	17	176/Skokie R	Lake Bluff	Overbank - Skokie River			
25	7	IL 176	Green Oaks	Overbank - Middle Fork	Atkinson Road reservoir	COE/ Drainage District/ Forest Preserve	
25	11	Ryders Ln	Highland Park	Overbank - Middle Fork			
23	6	Ravine Dr ¹					
23	7	Pleasant /Broadview ¹					
24	20	Old Trail ¹					
24	21	Central/Clifton/Elmwood ¹					
24	22	Sherwood/Ferndale ¹					
		Repetitive loss property(ies) at this location					